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REPORT

OF THE

SECRETARY OF AGRICULTURE.

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REPORT

OF THE

SECRETARY OF AGRICULTURE.

Mr. President:

In presenting my Tenth Annual Report of the work of the Department of Agriculture, the position of the producer from the soil in the development of our country is indicated.

It will be seen that he is making progress in the sciences and arts of agriculture; that the researches of the Department and of the experiment stations are enabling him to meet the requirements of a growing population for larger quantities of field products; that the time of the man and the yield of the acre become more responsive as more imperative demands are made upon them; that our research extends to all the States and Territories and to our island possessions; that every feature of interest in soils, plants, and animals has due attention; that explorations during the past year in extreme northern latitudes of Europe and Asia have resulted in accessions of plants suitable to our dry regions that promise to help in bringing them into profitable production.

The laws made by Congress at its last session to be put into execution by the Department have required and have received special attention. The meat law is being enforced with but little friction. At this time inspection is made in about 1,000 houses, and about 1,300 experts have been added to the inspection force of the Bureau of Animal Industry.

Rules have been made, as required by Congress, for the execution of the pure-food law, and hearings are being given to parties interested. The law requiring the extermination of the cattle fever tick (*Boophilus annulatus*) of the Southern States is being put in force and good results are following. Progress is being made in dealing with the gipsy and brown-tail moths in New England, imported parasites being successfully established. A beginning has been made in determining correct rules for grading grain and acquiring facts regarding methods of handling it in its movement toward the market.

The law providing for the humane treatment of live stock in transit is receiving careful consideration, and violations will be reported to the Department of Justice.

REVIEW OF PRODUCTION.

NATIONAL DEPENDENCE ON AGRICULTURE.

Economic revolution in the art and science of agriculture, which became noticeable in this country half a dozen years ago, has continued during 1906, with tremendous effect upon the nation's prosperity.

Crops so large as to be beyond any rational comprehension have strained the freight-carrying ability of railroads. Directly and indirectly the farmer has set up a demand for iron and steel that has

exceeded the productive power of the chief producer among nations. His contribution to the supply of loan capital has been beyond calculation and recalls the fact that the depression in the loan and investment mark t of 1903 was cleared away by the following crop.

Meanwhile the farmer has been a generous consumer, and has given powerful support to the market of the industrial producer, to the trade of the merchant, and to the wages of the workingman.

The farmer has become aware of the importance of the place that he occupies in the Republic, and in the pride of his occupation he is ready to offer this yearly account of himself to the people.

Preliminary crop estimates, subject to modification, must be used in the following review of the year's farm production, in advance of the final estimates of the Department, to be made a little later. The estimate of total agricultural wealth production has been continued from previous years and is again presented as an indication of the financial results of the year's operations. All attempts in the past, by subtracting from this grand total of value such products as are used wholly or in part in the making of other farm products in order that the farmer's net wealth production might be ascertained, have given no indication of what that net production was and have only obscured the matter.

TOTAL WEALTH PRODUCED.

Taken at that point in production at which they acquire commercial value, the farm products of the year, estimated for every detail presented by the census, have a farm value of $6,794,000,000. This is $485,000,000 above the value of 1905, $635,000,000 above 1904, $877,000,000 above 1903, and $2,077,000,000 above the census for 1899.

The value of the farm products of 1906 was 8 per cent greater than that of 1905, 10 per cent over 1904, 15 per cent over 1903, and 44 per cent over 1899.

A simple series of index numbers is readily constructed, which shows the progressive movement of wealth production by the farmer. The value of the products of 1899 being taken at 100, the value for 1903 stands at 125, for 1904 at 131, for 1905 at 134, and for 1906 at 144.

GAINS AND LOSSES.

Analysis into items of the grand total of wealth produced discovers that most of the increase over 1905 is due to horses and meat animals, and this is so partly because of the Department's much increased estimate of the number of these animals last January, and more largely because of higher prices than a year ago.

The price of milk ran higher than in 1905, but the value thus gained in wealth produced was perhaps more than offset by the lower prices for butter. So, in the case of poultry, the gain in live and drest poultry was more than balanced by the reduced egg value, since the mean farm price of eggs, as ascertained by this Department, declined from 18.7 cents during 1905 to 17 cents during 1906.

Crops, in a general balance of gain against loss in value, in comparison with the crops of 1905, have made substantial but not large gain—about $22,000,000; so that the previous foremost year in value of products, 1905, is exceeded by 1906 in both crops and animal products, and thus this year became the leading one in value of farm products in the history of the country by $485,000,000 over 1905.

On the side of gains over 1905, two short crops are conspicuous; hay leads with a gain of perhaps $80,000,000 in value, and the oat crop is second, with a gain of possibly $14,000,000. Barley and cotton-seed each promise a gain of $10,000,000; beet sugar, $7,000,000; tobacco, $2,000,000 or more; and hops, $1,000,000.

Against these gains are the losses of three abundant crops—$60,000,000, more or less, for wheat, and $10,000,000 each for corn and potatoes. The loss on rye and cane sugar may be about half a million dollars each, if anything. The net decline for all cereals may be $40,000,000.

The foregoing gains and losses in value, as well as others not mentioned, are exceedingly uncertain, and are to be regarded only as indicative of a general conclusion.

CHIEF CROPS.

All cereals.—While the value of all cereals dropt about $40,000,000 below the total of 1905, and about $12,000,000 below the total of 1904, the number of bushels for 1906, which was 4,688,000,000, was 120,000,000 bushels above the yield of 1905, 570,000,000 above the yield of 1904, and 835,000,000 bushels above the yield of 1903.

Corn remains by far the most valuable crop, and the figure that it may reach this year is $1,100,000,000 for 2,881,000,000 bushels—perhaps a little under the value of the next largest crop, that of 1905.

The cotton crop, fiber and seed combined, follows corn in order of value, altho it is only three-fifths of the value of the corn crop. No comments here must be regarded as indicating what the Department's estimate of the cotton-fiber production is to be. Upon the basis of the general commercial expectation of a crop, it should be worth to the grower nearly $640,000,000. In Texas alone the cotton crop is greater than that of British India and nearly three times that of Egypt, and it is half as much again as the crop of the world, outside of the United States, India, and Egypt.

Hay is a crop that receives small popular attention, and yet it is the third one in value if cotton seed is included in the cotton crop, and this year it approaches $600,000,000 for a product that is short by perhaps 8,000,000 tons.

Wheat.—The fourth crop in order of value is wheat, which this year may be worth over $450,000,000, a value that has been exceeded in several years; but in quantity this year's crop, with its 740,000,000 bushels, is only 8,000,000 bushels below the largest crop grown—that of 1901.

Oats.—The crop of oats, on account of unfavorable weather, has fallen below the usual amount, but its value will be perhaps not far under $300,000,000, or about the same as for 1905, and not much under the highest value reached, in 1902.

Potatoes.—With a probable crop of fully 300,000,000 bushels potatoes reach next to their highest production, which was in 1904; but the total value, $150,000,000, rests upon a rather low average per bushel and has been exceeded in other years.

Barley.—Seventh among the crops in order of value is barley, a cereal that has gained 21 per cent in production in seven years. The 145,000,000 bushels grown this year may be worth $65,000,000, both bushels and dollars being much more than for the highest preceding years—1904 being the previous record year for yield and 1902 for value.

Tobacco, which has shown weakness for several years on account of low prices, while not yet recovering its former place in pounds grown, has a crop this year of 629,000,000 pounds, with a value which is in close company with the three years of highest value, and it is expected will be worth $55,000,000, or perhaps $2,000,000 more.

Sugar.—A remarkable development has been made within a few years by now the ninth crop—beet sugar. The production in 1906 is placed at 345,000 long tons, with a value supposed to be near $34,000,000. Seven years ago only 72,972 tons were produced, and their value was about $7,000,000.

The year was a rather bad one for cane sugar, but in spite of this the total production of beet and cane sugar slightly exceeded the highest previous figure, altho in value of sugar the year stands second. The value of all kinds of sugar, sirup, and molasses reaches a total of $75,000,000, second only to 1904, which was cane sugar's best year.

Flaxseed.—The 27,000,000 bushels of flaxseed have been exceeded by three years, altho the value, $25,000,000, reaches the highest point.

Rice, standing twelfth in order, is another crop with its highest value, perhaps $18,000,000, altho in production the 770,000,000 pounds of rough rice are second to 1904. Markets that have developed in Hawaii and Porto Rico have helped to keep the price high enough to account for the total value placed upon the crop.

Rye has become a minor crop and has now fallen below rice in value. The crop of this year is below the larger crops of recent years, and is about 28,000,000 bushels, worth perhaps $17,000,000.

Hops.—The fourteenth crop is hops, which reached its largest dimensions this year with 56,000,000 pounds, and as high a value as it ever had, except in 1904, say, $7,000,000.

Summary.—On the whole, crop values have been neither notably high nor low in comparison with recent years, but the crops are so many in number that losses meet gains, and the crops have been on such a high price level in the general average that they have raised the total crop value somewhat above 1905 and the high preceding years. To reach a still higher point in this extraordinary series of high annual values than had been touched before is an achievement that deserves attention.

EXPORTS OF FARM PRODUCTS EXCEED FORMER YEARS.

Farm products continue to be so far beyond the national requirements that the farm still overshadows the mill, the factory, and the workshop in providing exports. With his surplus beyond the nation's need, the farmer has loaded the fleets of oceans. These products were exported to the value of $976,000,000 during the fiscal year ending June 30, 1906—enough to build a high-class railroad halfway around the earth. This is the largest amount ever reached by agricultural exports for this or any other country, and exceeded by $24,000,000 the extraordinary value of 1901, which had previously been the record year.

PRINCIPAL ITEMS.

Principal among the items that make the increase over the fiscal year 1905 are grain and its products, chiefly wheat and flour, for which the gain was $79,000,000; packing-house products, for which the gain was over $37,000,000; cotton, $19,600,000; various seeds,

$6,355,000; dairy products, $3,900,000; and live animals, $2,400,000. Products exhibiting a decrease were mostly inconsiderable. In hops, the decline was $1,355,000; tobacco, $992,000; vegetable oils, $726,000; fruits, $440,000.

HIGHEST VALUE OF COTTON EXPORTS.

Cotton maintains its long lead over other chief exports, with a value of $401,000,000 for 3,634,000,000 pounds, so that the latest year was exceeded only by 1898, 1899, and 1905 in quantity exported; but in value of exported cotton the figures for 1906 are $19,600,000 higher than for 1905, which was previously the record year, and $29,000,000 higher than for 1904, which was third in order in the value of these exports.

In exports of grain and grain products for 1906 the value again reached a high amount and has been exceeded only 13 times in the last fifty-six years. The value of this class of exports last year was almost exactly the average of the preceding twenty-five years.

LEADING YEAR FOR PACKING-HOUSE PRODUCTS.

Packing-house products are another class of exports that found their leading year in value in 1906, the amount being $207,700,000. No previous year had reached $200,000,000, and only two years had past $180,000,000. The value of exported fresh beef, $24,300,000, was well up to the average of recent years; lard exports to the value of $60,000,000 and a quantity of 742,000,000 pounds went far beyond the highest figure of preceding years in both respects; bacon took an upward turn with exports valued at $36,000,000 for 361,000,000 pounds and rose well up toward the higher export years of the past. The level of recent years was reached in the exports of hams, their value being $20,000,000 and weight 194,000,000 pounds. The highest exports, both in quantity and value, of oleo oil in previous years were far overtopt by the exports of this commodity in 1906, and the 210,000,000 pounds exported were valued at $17,500,000.

IMPORTS OF FARM PRODUCTS.

The imports as well as the exports of agricultural products reached their highest value in 1906, when the amount was $554,000,000, or less than one-fourth of a million dollars over the value of 1905, which was then the highest record. The principal increases over 1905 in these imports were $20,000,000 for packing-house products, almost entirely composed of hides, skins, hair, and bristles; $4,400,000 for tobacco; $2,700,000 for vegetable fibers; $1,900,000 each for seeds and vegetable oils; $1,800,000 for fruits; $1,200,000 for nuts; and $1,100,000 for vegetables. On the other hand, there were decreases in imports which nearly balanced the increases, and principal among these were coffee, with a loss of $11,000,000; sugar and molasses, with a loss of $12,600,000; wool and silk, with a loss of $7,000,000 each; and tea, with a loss of $1,650,000.

The principal imported articles are the same year after year, and among them for 1906 the imports of packing-house products were valued at $96,000,000; of sugar and molasses, $86,000,000; of coffee, $73,000,000; of silk, $54,000,000; of vegetable fibers, $50,000,000; of wool, $39,000,000; of tobacco, $22,000,000; of fruits, $21,500,000; of tea, $14,600,000; and of vegetable oils, $12,600,000.

FOREIGN TRADE IN FOREST PRODUCTS.

On account of the increasing value of forest products, the exports of these commodities in 1906 reached a considerably higher figure than ever before, with a value of $77,000,000, or $13,748,000 more than in 1905. The imports of these products also increased in value by $3,000,000; all items exhibit an increase except india rubber, the imports of which declined by $4,800,000. In total value the imports of forest products were $95,700,000 in 1906, an amount far above that of any preceding year except 1905.

BALANCE OF TRADE.

The so-called balance of trade in the international exchange of agricultural commodities continues to run in favor of this country by an enormous amount; for 1906 the agricultural exports exceeded similar imports by $433,000,000, an amount which places this year with the seven high years beginning with 1898 and much above the balance of 1905. This new foreign credit, which equaled that of a rich nation, was mostly offset by large borrowings in this country from Europe for the purpose of enlarging railroads and other capital.

While the farmer placed to the National credit in other countries $433,000,000 in 1906, other producers, all included, secured a balance in favor of this country of only $85,000,000. During the last seventeen years the farmer has built up a balance of trade in foreign exchange of agricultural products amounting to $6,068,000,000, while all other producers find themselves at the end of the same period with a total on the debtor side of the account to the extent of $459,000,000.

INCREASE OF FARMING CAPITAL.

Having produced fabulous wealth during the year and having sent to foreign countries out of the wealth of the preceding year enough to pay the interest-bearing national debt, the farmer may now take account of his farming capital. The large rate of increase in its value since 1900 is not a mere matter of a higher price level and higher land values. In the meantime the farmer has earned a surplus income, much of which he has invested in his farming equipment, in buildings, in many improvements, in live stock, in machinery, and in furtherance of the comforts and pleasures of living.

REAL ESTATE AND FARM EQUIPMENT.

The farm real estate, as ascertained by this Department last year, increased in value $6,131,000,000 since the census year, or enough to raise the census value to $22,745,000,000. Domestic animals were worth $2,979,000,000, according to the census enumerators, and now they are estimated to be worth more than $4,000,000,000. There has been a very active demand for implements and machinery, not only by farmers who have become financially able for the first time to buy, as in the South, but by farmers already provided with them, who have needed to reduce their dependence upon human labor by getting more serviceable machines.

If real estate, domestic animals, other live stock, and implements and machinery are combined, the farmers' capital, as composed of these items, has increased by perhaps $8,000,000,000 since the census valuation, or about 40 per cent, and now amounts to perhaps $28,000,000,000.

DOMESTIC ANIMALS.

The domestic animals of the farm number about 200,000,000 at the time for which it is estimated by the Department, which is January 1. Strictly beef cattle, sheep, and swine are each one-fourth of the total, and dairy cows and draft animals each about one-tenth. The value of these animals has increased during the year, and only a very rough estimate can now say how much, in advance of the careful estimate to be made in January. Perhaps the gain is about $400,000,000; at any rate, the increase seems to be as much as 10 per cent.

MEAT SUPPLY.

NUMBER OF ANIMALS SLAUGHTERED.

Upon the farmers' vast herds of meat animals the nation depends for its most expensive class of foods in various kinds of meat and for one-third of its dietary. The figures of meat production, which are the result of a recent large and searching investigation by this Department, strikingly express the magnitude of the farmer's occupation, as evidenced by only one of its branches, and the largeness of its performance in national sustenance and exports.

In the last census year, 1900, 93,502,000 meat animals were slaughtered and exported, and of these 18,809,000 were cattle, including calves; 24,548,000 were sheep, including lambs; and over one-half, or 50,145,000, were hogs. Every time the clock ticks a second during ten hours of a workday the farmer drives nine meat animals to the butcher.

POUNDS OF MEAT PRODUCED.

The meat production of 1900, in terms of drest weight and weight of edible parts not included in drest weight, was 19,186,330,000 pounds, of which 2,433,035,000 pounds, or 12.68 per cent, were exported, so that the national consumption was 16,753,295,000 pounds.

Such great numbers may be better understood if they are reduced to the average of the census private family, 4.6 persons. To such a family in 1900 the farmer supplied 49 pounds of veal, 431 pounds of beef, 30 pounds of lamb, 39 pounds of mutton, and 465 pounds of pork, including lard, or, in all, 1,014 pounds of meat, amounting to half a ton.

If the exports had been consumed at home, they would have given to each family more beef than the foregoing by 50 pounds, more pork by 97 pounds, or together 147 pounds.

In the consumption of meat, exprest in terms of entire animals, each family asks the farmer for over one-third of a calf, over two-thirds of a steer or cow, over three-fourths of a lamb, nearly three-fourths of a sheep, and two and one-half hogs, and the farmer responds so liberally that one-eighth of his supply is left over for the foreigner. It is upon the selling of this surplus in foreign countries that the farmer depends for the maintenance of profitable prices for his meat animals.

LARGE PLACE OF THE SURPLUS IN THE WORLD'S TRADE.

This fraction of one-eighth is small, but it becomes remarkably magnified when it crosses the Atlantic Ocean. The national surplus of meat for one year, if composed of the different kinds as actually

used in consumption, is sufficient to feed either the United Kingdom or the German Empire for nearly half a year, or both for nearly one-fourth of a year, and the population of these two countries in 1901 was 98,000,000, as compared with a population of 76,000,000 in this country the year before.

This little fraction of the national product of meat which goes to other countries looks large when viewed in another aspect. In the world's international trade in packing-house products and live meat animals the place occupied by the exports from the United States is indicated by about 40 per cent of the total value.

IMPORTANCE OF SWINE.

As a meat producer, the importance of the hog appears in the foregoing statement. The yearly turnover or slaughter of hogs is equal to about four-fifths of the number on hand June 1, and the meat, including lard, produced in 1900 was 9,279,583,000 pounds, or more than half a billion pounds over the 8,771,263,000 pounds of veal and beef, and over eight times the 1,135,484,000 pounds of lamb and mutton.

In one State alone, Iowa, the pork products for 1906, including lard, are equivalent in pounds to nearly the entire exports of the meat products of swine in 1900. Should Iowa suddenly lose its swine, for the time being exports of their products must substantially cease or the home consumption of them be reduced one-fifth.

Briefly mentioned, such are some of the main results of the Department's investigation of the meat supply. They indicate the proportions of the part that the farmer of this country takes, in only one direction of his work, as a provider of meat to now 85,000,000 fellow-countrymen and to the rest of mankind.

CONSUMERS' YEARLY MEAT BILL.

Meat consumers, as well as farmers who are meat producers, have concern with the national dietary. This nutritive element contributes one-third or more of the total assimilated nutrients of the dietary, both in pounds of protein, or flesh-forming material, and in calories of energy. In expense to the consumer the fraction is undoubtedly much larger. The investigations of the National Bureau of Labor into the retail prices of food indicate, for the many representative family budgets included in the investigations, that the average retail price of meat, for all kinds in the proportions of actual consumption, was 12¾ cents in 1900, 13 cents in 1901, and 13½ cents in 1905; the average increased, perhaps, to 13¾, or at the most to 14, cents in 1906.

At these average meat prices and with the meat consumption of 1900, the national retail meat bill was $2,052,279,000 in 1900, and it was $2,303,578,000 to $2,345,461,000 in 1906. Every increase of one-fourth of a cent per pound in the national average retail price of meat raises the total yearly expense to consumers by $41,883,000. The increase of one cent a pound since 1900 cost consumers this year $167,533,000.

FUTURE PRODUCTION.

FAULTS OF THE PAST.

The mighty production of the farm for one-third of a century has come out of an agriculture having many faults. In a large degree there has been one-crop farming; crop rotation, as practised, has often

been too short and unwise; the grasses and leguminous forage crops have been neglected, domestic animals have not sufficiently entered into the farm economy, and many dairy cows have been kept at a loss. The fertilizers made on the farm have been regarded as a nuisance in some regions; they have been wasted and misapplied by many farmers; humus has not been plowed into the ground as generally as it should have been; and in many a place the unprotected soil has been washt into the streams.

ECONOMIC JUSTIFICATION.

This, in few words, is the historic story of agriculture in a new country; yet the course of agriculture in this country, bad as it may seem in its unscientific aspect, has had large economic justification. While pioneers, poor and in debt, are establishing themselves they have no capital, even if they had the knowledge, with which to carry on agriculture to the satisfaction of the critic. They must have buildings, machinery, and live stock, even at the expense of the soil.

Millions upon millions of acres of fresh land have been coming into production faster than domestic consumption has required, and, at times, beyond the takings of importing countries. For many years the farmer was threatened with 40-cent wheat, 20-cent corn, and 5-cent cotton, and at times he was face to face with the hard conditions implied in these destructive prices. A more scientific agriculture would have raised wheat that no one wanted to eat, corn to store on the farm and perhaps eventually to be used for fuel, and cotton not worth the picking.

LARGER PRODUCTION INDICATED.

So it has happened, with reason, that the production per acre has been low; but there is no likelihood that low production is fixt and that the farmer must continue his extensive system. When consumption demands and when prices sustain, the farmer will respond. The doors of knowledge and example are opening wider to him.

There is abundant information concerning crop rotation, the dependence of high production upon the domestic animals, concerning grasses, clover, and alfalfa, and concerning the mixing of vegetable matter with the soil. Systems of farm management and soil treatment have assumed greater importance in their effect upon production; and there is the breeding of plants, which alone can multiply production so as to glut the market.

MULTIPLICATION OF THE COTTON CROP.

If there were need to do so, the cotton farmer and planter could double the present crop of two-fifths of a bale per acre, and the feat would need nothing more than demonstrated and well-understood principles of farm management. It would be no work of magic to multiply the production of cotton per acre by 3 and get a bale and a quarter; and, besides this, the planter has more than three times the present actual acreage in cotton readily available and awaiting his use. More than the present area of cotton can thus be grown in a three-year crop rotation when the needs of the world demand it.

INCREASE OF CORN.

In accordance with principles demonstrated, known, and applicable, hints of which have been given, the corn crop per acre can be increased by one-half within a quarter of a century, and without any pretense that the limit has been reached. No wizard's services are needed for this, but just education.

MORE WHEAT PER ACRE.

The same statement is applicable to wheat. There is no sensible reason why half as much again wheat may not be had from an acre within less than a generation of time. It is only a question of knowledge, of education, of cultural system, and of farm management, all of which learning is and will be at the service of the farmer as he needs it.

GAIN IN OTHER CROPS.

Equally feasible is a 50 per cent increase in the crops per acre of oats, barley, rye, and buckwheat. Potatoes, instead of growing less than 100 bushels per acre, should double their production. Wherever only 600 to 800 pounds of tobacco are got from an acre, three-fourths of a ton is the prospect.

Fruits, berries, and vegetables have a future too large to estimate. The cannery and the railway fast freight and refrigerator car have overcome obstacles of latitude, of longitude, and of season, and there is every indication that the farmer can supply any possible demand for these foods at home or abroad.

ANIMAL PRODUCTS.

Farmers will learn how to feed more prolific breeds and strains of swine than the ones which they are now chiefly raising, and thus will pork and its products be increased per individual of the permanent stock of hogs. One-fourth of the dairy cows of the country do not pay for their feed, and more than half of them do not return any profit; in proportion as the dairyman weighs the milk of each cow and applies the Babcock test will he increase the supply of milk, butter, and cheese. It is merely a matter of education.

Poultry is one of the steady and helpful sources of farm income. Movements are already on foot which may be expected to increase the egg production per hen by at least a dozen per year within a generation; and there are poultrymen who are not enthusiasts who foretell double that increase. If the hens of this year had each laid a dozen eggs more than they did, the increased value of this product would have been possibly $50,000,000.

A MATTER OF EDUCATION.

The farmer will not fail the nation if the nation does not fail the farmer. He will need education to know the powers of the soil which are now hidden from him. The prospective yearly expenditure of $10,000,000 for educational and research work by Nation and States, with such increases as may come from time to time, must have enormous effects. There may be agricultural schools for the small children, and agricultural high schools for the larger ones, and their education will be continued in the colleges.

The work of the Department of Agriculture has already had results which are valued at hundreds of millions of dollars annually, and yet

the Department feels that it has barely crost the threshold of its mission of discovery and education. Cooperating to the same ends are 60 experiment stations in 51 States and Territories, the 63 agricultural colleges, thousands of farmers' institute meetings yearly, many excellent agricultural periodical publications and new instructive books. Then there is a new line of work which is so productive of results that it is constantly extending, and that is the demonstration farm, the encouragement of individual farmers to change their agriculture so as to multiply their yields and their profits, and thus afford object lessons to other farmers.

Thus it appears that forces are now at work which will very considerably increase the production of the farms within a generation, and which promise to continue the increase indefinitely. He who would write the last chapter of the progress of the agriculture of this country must await the procession of the centuries.

OPENING OF A NEW ERA.

The farmer is financially in a position now to do what he could not have done previous to the recent years of his prosperity.

ADVANCE OF FARMERS' WELFARE.

National welfare has been promoted by few revolutions in agricultural economics to the extent that it has been and will be promoted by 10-cent cotton. The greater part of the cotton planters are out of their former bondage to future maintenance, and they are paying no enormous rates of interest for advancements—rates which were estimated fifteen years ago to average 40 per cent a year.

In the Middle West the prosperity of the farmers during the last half dozen years and over has advanced in such mass and with such speed that no parallel can be found in the economic history of agriculture. One of the great changes that have come over this region is the conversion of a million agricultural debtors, paying high rates of interest and finding great difficulty in procuring the wherewithal out of prices much too low, into financially independent farmers, debt-free, and begging the banks to receive their savings at as small a rate of interest as 2 per cent.

POWER OF THE FARMERS' NEW CAPITAL.

Farmers are using their new capital to abolish the waste places of the land. The river is leveed and alluvial bottoms subject to overflow become worth hundreds of dollars per acre for vegetables; a marsh is drained by ditches and tiles and celery makes it the most valuable land in the county; semiarid land is constantly cultivated so as to make a mulch of finely pulverized earth on the surface, and the crops that it will grow make the farmer prosperous; durum wheat or alfalfa is introduced and again the semiarid wastes are made to do the will of the cultivator; leguminous plants give humus and nitrogen to the sandy waste, to the use and profit of the farmer; the unused rocky, stony field or mountain side, offensive both to the economic and to the esthetic eye, blossoms with the apple, the peach, the pear, and the plum, and adds to the evidences that every square foot of the land may be made productive unless it is arid; and even then irrigation works, as far as water is available, swell the evidence. Along all of these lines of production farmers are using their newly acquired capital and are progressing as never before in their prosperity.

Formerly there was an abundance of farm labor and a dearth of farming capital; now these conditions are reversed and labor is scarce and capital abundant. Notwithstanding the farmers' inability to do some things for want of labor, the new situation is a great improvement upon the old one. The farmer can now employ every labor-saving device and thus reduce both the labor and the cost of production; he can raise his land to a higher state of fertility than can be made by chemical fertilizers alone, because he can advance the needed capital for permanent soil improvement and is in a position to await results; he can produce things that require years for the first crop, as in the case of fruits; he can provide such capital as is needed to distribute his products and thus cooperation is open to him to a greater extent than ever before; he can secure a better education for his children to the end, among other things, that they may do better with the old farm than he did.

PROMISING OUTLOOK.

The farmer's standard of living is rising higher and higher. The common things of his farm go to the city to become luxuries. He is becoming a traveler; and he has his telephone and his daily mail and newspaper. His life is healthful to body and sane to mind, and the noise and fever of the city have not become the craving of his nerves, nor his ideal of the everyday pleasures of life. A new dignity has come to agriculture, along with its economic strength; and the farmer has a new horizon far back of that of his prairie and his mountains, which is more promising than the sky-line of the city.

For the abundance that the Creator has sustained the farmer in supplying, for the stability of the national agriculture, and for the comforting prospect of a potent future, there are many evidences that the people are ready to join in a day of reverent and joyous Thanksgiving.

It is no little gratification to the head of this Department in presenting the foregoing picture of the farmer's place in the economy of the country and picturing the possibilities of his future to realize that this Department and its work have had an important share in the development which has culminated in the farmer's present prosperity, and that they are bound, if intelligently and generously administered, to play an important part in the future of American agriculture. With this thought in mind I will proceed to present for your consideration a review of the various channels thru which the Department performs its important work and to place on record what has been done thru them during the past year.

WEATHER BUREAU.

FORECASTS AND WARNINGS.

The Weather Bureau has issued warnings of dangerous gales on the Great Lakes and along the seacoasts, and has kept the great commercial and agricultural interests of the country as fully advised as possible of the coming of adverse weather conditions.

EXTENSION OF THE FIELD OF OBSERVATION.

Its field of observation is being gradually extended in the hope that a view of the atmospheric conditions which prevail over the great oceanic and continental areas will prove of especial value in making

forecasts for this country. The two points from which advices of atmospheric changes are most desired at present are Siberia and the region in and about Bering Sea. It is hoped to obtain reports from Siberia thru the courtesy of the Russian Meteorological Service. The laying of a cable by the United States Signal Service, connecting Alaska with this country, makes it feasible to secure much-desired weather reports from that part of the globe.

EXTENSION OF STORM-WARNING SERVICE TO VESSELS AT SEA.

During the year a plan has been perfected whereby vessels at sea equipped with wireless telegraphic apparatus may receive warnings of severe storms if within communicating distance of shore stations, or of other vessels which have received a warning.

OBSERVATORY BUILDINGS.

Five observatory buildings have been completed during the year, and one (the physical laboratory at Mount Weather, Va.) has been partially completed. The number of buildings of all classes now owned and occupied by the Weather Bureau is 41.

DISTRIBUTION OF FORECASTS THRU TELEPHONE EXCHANGES.

The number of telephone subscribers receiving the daily forecasts on June 30, 1905, was 464,738. This number was augmented during the year by over half a million, so that at the close of this fiscal year more than a million telephone subscribers were receiving the daily forecasts.

INVESTIGATION OF FROST CONDITIONS IN CRANBERRY DISTRICTS.

A special investigation has been carried on during a part of the year, having as its object the establishment of a scientific basis for accurate frost predictions in the cranberry regions of the country, especially in Wisconsin. The conditions of both soil and air which shortly precede and accompany frost have been studied closely, and much valuable data have been secured.

INCREASE IN THE WEATHER SERVICE.

The utilities of the Weather Bureau are such that there is a constant and growing demand for an extension of the service so as to provide for telegraphing and publishing more meteorological data and establishing additional Weather Bureau stations. However, special effort is made to meet these demands with the existing appropriation, and no request that involves asking Congress for additional funds is honored except after a careful and thoro investigation of the necessities of the case.

There is already an extensive output of meteorological information that comes from the 183 full meteorological stations maintained by the Bureau and from several hundred stations reporting only temperature and rainfall. The daily output finds its way to the public mainly thru the columns of the newspapers and in the maps and bulletins issued at

Washington and outlying stations. Outside of Washington there are 105 stations which issue an aggregate of 25,000 weather maps daily, making a yearly issue of over 8,000,000 copies. The number of monthly climatological reports printed at 40 different section centers is 30,944, being an average of about 700 copies per month from each center; these contain the daily climatological features of various climatic districts. There is a constant demand from agricultural, commercial, and shipping interests for an additional amount of such data.

MOUNT WEATHER RESEARCH OBSERVATORY.

Progress has been made in the establishment of the Mount Weather Research Observatory. A station of the first order has been maintained thruout the year for taking and telegraphing reports that are useful in making forecasts.

In the preparation for kite and balloon work, a number of important instruments have been installed and made ready for systematic work. Observations of the upper air are now being regularly taken in concert with similar aerial research institutions in foreign countries.

The interior finishings of the magnetic observatory buildings, the erection of the piers, and the installation of the magnetic instruments were completed during the year, and automatic and other records are now being continuously made.

RECORDS OF EARTHQUAKES.

The attention drawn to scientific observation of earthquakes by the calamity that befell San Francisco on April 18, last, has prompted the Department to authorize the Weather Bureau to install an additional number of instruments at places of observation where the Department owns buildings and suitable ground. It is probable that during the coming year about 15 or 20 additional stations will be equipped with seismographs, so that the progress across our continent of earth vibrations can be more accurately measured and the data submitted for scientific discussion. These additional observations can be secured with only the expense involved in the purchase of instruments and their installation.

BUREAU OF ANIMAL INDUSTRY.

THE MEAT INSPECTION.

Meat inspection has been for several months a very live topic before the public. During the year the Federal meat inspection was conducted by the Bureau of Animal Industry at 163 establishments in 58 cities, and 42,901,284 animals were inspected at the time of slaughter, nearly all of them having also been previously inspected in stock yards. This represents the greatest amount of work done in any one year since the inspection was inaugurated in 1891. Of the animals inspected, 158,953 carcasses and 126,159 parts of carcasses were condemned for disease or other cause. The total cost of the meat inspection, including the microscopic inspection of pork for export to certain countries, was $852,561.70.

The importance of more thoro meat inspection and sanitation has been forcibly shown by the recent agitation and investigations relating to some of the packing-house methods. The new law which was designed to correct certain evils was past by Congress June 30, 1906,

and hence the work of the fiscal year under review was performed under former laws, which were, in many respects, defective and unsatisfactory. The act of March 3, 1891, as amended March 2, 1895, provided for the inspection of all live cattle intended for export or whose carcasses or products were intended for export; also for the mandatory ante-mortem inspection of cattle, sheep, and hogs, and the additional permissive post-mortem inspection of their carcasses for interstate trade. It has never been possible, however, to apply the inspection to all the establishments coming within the law, since the appropriations have been insufficient for that purpose. Many establishments which desired inspection have had to be refused because of lack of funds to extend the service. Many that should have been compelled to have inspection were able to avoid it, as the former laws compelled inspection only in the case of export beef.

The law gave the Department no authority whatever to control the sanitation of abattoirs and packing houses, or to prevent adulteration or the use of chemicals and preservatives; nor was any authority given for following up meats which had once been inspected and past immediately after slaughter, or for condemning any such meat which might afterwards have become unwholesome or unclean before or during the process of canning or packing or before being placed on the market. The inspection was therefore practically limited to the ante-mortem inspection of animals and the inspection of the carcasses immediately after slaughter. The meat found free from disease and otherwise wholesome at the time of this post-mortem inspection was properly marked, and that found diseased or unwholesome was destroyed. This inspection was efficient so far as it went, and it went as far as the law and the limited appropriations permitted. In its efforts to maintain an efficient inspection the Department sometimes even assumed authority not conferred by law, notably by requiring the destruction of condemned carcasses. In all the recent agitation the wholesomeness of the inspected fresh meat has not been seriously questioned. The disclosures of unsatisfactory conditions have related almost wholly to matters over which the Department had no legal control, such as the preparation of sausages, canned and cured meats, etc., the use of preservatives, and the insanitary condition and methods of the packing houses.

Realizing the shortcomings of the old law, the Department has several times in the past recommended the enactment of new legislation and the increase of appropriations for the extension and improvement of the service. Bills designed to remedy some of the defects were at different times introduced in Congress but failed to pass.

Even before the appearance of recent publications criticizing the insanitary conditions at the Chicago stock yards and packing houses, and reflecting upon the Federal meat-inspection service, steps had been taken to investigate these matters. A committee consisting of Dr. John R. Mohler, chief of the Pathological Division of the Bureau of Animal Industry, Dr. Rice P. Steddom, chief of the Inspection Division of that Bureau, and Mr. George P. McCabe, Solicitor of the Department, was sent to Chicago and made a thoro investigation. They made an exhaustive report, which was promptly transmitted to the President and was afterwards by him laid before Congress. An independent investigation was also made under the President's direc-

tion by Messrs. Charles P. Neill and James B. Reynolds. Prompt and vigorous measures were taken to remedy the conditions disclosed by the reports of these committees, but it was realized that the Department could do very little under existing law and that the real remedy lay in new legislation backed by public sentiment.

Such new legislation was provided by Congress in the so-called meat-inspection amendment to the agricultural appropriation act of June 30, 1906. This law provides for a more thoro and comprehensive inspection system and makes a permanent annual appropriation of $3,000,000 to pay the cost of the inspection. With the greater authority now vested in the Secretary of Agriculture and with the largely increased appropriation, the service will be greatly extended in scope and in the number of establishments and quantity of product covered. The inspection will be extended as rapidly as possible to establishments engaged in interstate or foreign commerce and which come within the law. It will be applied not only to the live animals before slaughter and their carcasses at the time of slaughter, as heretofore, but also to the meats and meat food products in all the subsequent stages and processes of preparation, curing, canning, etc. Sanitary equipment, conditions, and methods will be required, the use of harmful chemicals and preservatives and of false and misleading labels will be prevented, and the transportation of meat in interstate and foreign commerce will be supervised and regulated. It is probable that it will be necessary to request Congress to appropriate an even larger sum to provide inspection for all establishments embraced within the law.

American live stock has long been considered the healthiest in the world. With our enlarged and improved inspection system, the stamp of the Government will be more than ever a mark of wholesomeness.

We must not imagine, however, that since the packing houses have been cleaned up and the inspection improved all the meat found in our local markets may be considered clean and wholesome. It must be borne in mind that the Federal jurisdiction is limited to interstate and foreign commerce, and that this inspection can legally be applied only to establishments doing an interstate or foreign business. To be sure, the Department insists on inspecting the entire output of each establishment at which its inspection is maintained, even tho part of the product is to be consumed within the State; but the Federal inspection does not and can not reach the establishments doing business exclusively within a State. The Department, under the new law, can and will enforce cleanliness and sanitation in the establishments doing an interstate and export business, but it is powerless to reach the local houses. The latter must be lookt after by the State and municipal authorities. Each State or community must protect itself against unwholesome meats originating within the State. In the absence of an efficient local inspection the consumer's only safety lies in seeing that meat bears the Government label.

INSPECTION OF EXPORT ANIMALS.

The export trade in live animals is fostered by the inspection conducted by the Bureau of Animal Industry. During the fiscal year more than 1,000,000 inspections were made before exportation, and over half a million animals were again inspected on arrival at British ports by Bureau inspectors stationed there. Seven hundred and forty-nine inspections of vessels carrying export animals were made before

clearance, and they were required to conform to certain regulations as to space, fittings, attendants, feed, water, ventilation, etc. The percentage of animals lost in transit was less than one-quarter of 1 per cent.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

Our domestic live stock is protected from the contagion of destructive diseases which exist in other parts of the world by a rigid system of inspection and quarantine of imported animals. In this service during the year 168,600 animals were inspected, and 1,898 of these were quarantined.

The quarantine stations on the Atlantic seaboard, with one exception, are in satisfactory condition. The station near Baltimore will soon have to be abandoned because of the dilapidated condition of the buildings and the building up of that locality. When a suitable location is secured an appropriation by Congress for the equipment of the new station will be necessary.

CONTROL OF CONTAGIOUS DISEASES.

The work for the control and eradication of contagious diseases of live stock in our own country has been attended with encouraging results. Sheep scab and cattle mange, which a few years ago had spread over the greater part of the Western States, are gradually yielding to our efforts. It is believed that their complete eradication will be only a matter of a few years. During the year sheep scab has been greatly diminished in Arizona and Idaho, and practically stamped out in Utah and Wyoming. Even more rapid progress has been made with cattle mange. Washington and Oregon, and large portions of Kansas, Colorado, Wyoming, Texas, New Mexico, and Oklahoma, have been freed from this disease and released from quarantine, and it is expected that the same will soon be true of extensive areas in North Dakota and South Dakota and other portions of Wyoming and Texas.

Maladie du coït, or dourine, an insidious venereal disease of horses, which existed in portions of South Dakota, Nebraska, and Iowa, is now believed to have been eradicated, after several years of vigilant work. Out of 965 inspections during the year no positive cases and but 3 suspicious cases were found.

ERADICATION OF THE TEXAS-FEVER TICK.

Under the provisions of the act of Congress approved June 30, 1906, appropriating $82,500 to enable the Secretary of Agriculture to undertake experimental work in cooperation with State authorities in eradicating the ticks transmitting Southern cattle fever, the Department has for some months past been assisting the States and Territories from California to Virginia along these lines. Anticipating the action of Congress an investigation was made respecting the laws of the various States, and thru the various attorneys-general inquiry was made relative to the existence of State laws under which the Government could undertake the work of tick eradication. It was found that, while some State laws afford ample provisions, other States either have no law bearing on the subject, or the statutes are inadequate. The table following shows the particular points covered by the investigation and the general trend of the information received.

Provisions of State laws relating to quarantine, disinfection, etc.

State.	Questions and answers.			
	Are local officers authorized and empowered to enter premises to inspect live stock and enforce quarantine, including counties, districts, farms, and ranches, and to control the movement of live stock?	Are such officers empowered to enforce such disinfection of animals and premises as may be necessary?	Are State officials authorized to issue rules and regulations establishing and maintaining quarantine lines?	May the State confer authority upon Federal representatives to act as officials of the State in such matters?
Alabama	No live-stock quarantine or sanitary law.			
Arkansas	Peace officers may enforce quarantine lines fixt by law and by the United States.	No	No	
California	Yes	Impliedly	Yes	As county officials only.
Florida	No live-stock quarantine or sanitary law.			
Georgia	Yes; impliedly so	Yes	Yes	Not prevented.
Indian Territory	No law to cover these matters.			
Kentucky	Yes	Yes	Yes	Yes.
Louisiana	Yes; impliedly so	Yes	Yes	No.
Mississippi	No live-stock quarantine or sanitary law.			
Missouri	No	No	No	No.
North Carolina	Yes	No	Yes	Yes.
Oklahoma	Yes	Yes	Yes	Yes.
South Carolina	No law to cover these matters.			
Tennessee	Yes	Yes	Yes	Not prevented.
Texas	Yes	Yes	Yes	No.
Virginia	Yes	Yes	Yes	Yes.

The matter was early taken up with the proper officials in the States and Territories interested and arrangements were made for the Department to cooperate with them to the extent that their respective laws would permit. Under these arrangements the work has been done in close cooperation with the local authorities, who were permitted to designate the counties or localities to be covered and to recommend for appointment as agents of the Department men acquainted with the local conditions in the respective localities.

The territory in which it was desired to operate was divided into five sections, as follows:

1. California.
2. Texas, Oklahoma, Missouri, Arkansas, and Louisiana.
3. Kentucky, Tennessee, Alabama, and Mississippi.
4. Georgia and South Carolina.
5. Virginia and North Carolina.

The work was organized as soon as possible after the passage of the law, but it was late in July before it could be begun at all, and even later before it could be taken up in some sections.

As the conditions in the different sections were widely divergent, the plans of procedure and methods employed necessarily varied greatly. In some States meetings were held at which the subject of tick eradication was discust with farmers, stockmen, and other interested citizens. These meetings were intended to be largely educational, but they gave an opportunity to petition State authorities for relief and to express preference for local inspectors, thus developing an enthusiasm and interest that can only come from a close personal identification with an enterprise of this sort. In some places it was necessary to employ inspectors who could live in the saddle and wield a lasso like a cowboy. These men worked in groups of about a dozen, each group having a cook and a camping outfit. They covered their territory systematically, roping and examining cattle wherever found,

and informing the owners of infested animals of the most practical method of getting rid of the ticks. It was found advisable to buy a carload of crude petroleum (in barrels) for use in the treatment of infested animals. This oil was distributed and used under the immediate supervision of inspectors of the Department in the southeastern States, and was doubtless the means of doing what could have been done in no other way, as the crude oil is difficult to obtain in small quantities and at points far distant from its production.

The following table shows by States the number of herds inspected, the number of cattle inspected, the number found free of ticks, and the number found to be infested—the grand total of inspections being 29,315 herds containing 522,529 cattle:

Results of inspection work to October 31, 1906.

State.	Inspections.				Number of counties.
	Herds.	Cattle.			
		Free.	Infected.	Total.	
Alabama	780	4	5,550	5,554	2
Arkansas	1,527	6,671	2,332	9,003	2
California	1,015	67,517	58,889	126,406	11
Georgia	4,474	10,053	6,365	16,418	7
Kentucky[a]	4,077	13,653	7,332	20,985	4
Missouri	126	3,000	1,430	4,430	3
North Carolina					
Oklahoma	10,589	97,860	16,972	114,832	5
Tennessee[b]	6,317	23,204	15,840	39,044	17
Texas	410	86,682	99,175	185,857	17
Virginia					
Total	29,315	308,644	213,885	522,529	68

[a] In addition, in Kentucky 1,386 herds and 6,604 cattle were reinspected.
[b] In addition, in Tennessee 822 herds and 4,174 cattle were reinspected.

The work is still progressing in some States, but will be practically discontinued about December 1 on account of the lack of funds. The outlook for next season's operations in the different infested sections is very encouraging, and the work should be resumed in the early spring.

In considering the work done and the results attained thus far it should be borne in mind that the season was well advanced before the law was past, and that, altho some steps were taken in anticipation of its passage, yet the actual plans and organization for the work were late in formation. It should also be remembered that the amount appropriated was only intended to be used to inaugurate the work, and yet, as set forth above, employees of the Department have inspected 29,315 herds, containing 522,529 cattle, and have, in connection with local authorities, so attended to their disinfection and to the supervision thereof that forty whole counties and parts of eleven other counties, with an aggregate area of almost 50,000 square miles, will probably be released from quarantine before the end of this fiscal year. This is an area larger than that of the entire State of Virginia. Plans are laid and specific work is outlined for resumption in the early spring. The State officers, cattle owners, and others affected are intensely interested; educational work will be carried on, and there is every reason to believe that, with proper funds at the disposal of the Department next season, large inroads may be made into the territory now quarantined, and hundreds of thousands of cattle be given an unrestricted market, thus giving direct results to an immense number

of people. This will stimulate interest in those States in which active interest is now lacking and will doubtless result in a more general movement against the cattle tick.

If the Congress at its next session will appropriate $250,000 for extending these operations and will continue to adequately sustain them, and the States interested will do their part in the way of enacting favorable laws and appropriating money to be used in this cooperative work, it is only a question of time when the southern cattle tick in this country will be a thing of the past.

SCIENTIFIC INVESTIGATION OF DISEASES.

The scientific investigations of contagious diseases by the Bureau of Animal Industry have yielded results of especial importance with regard to tuberculosis and hog cholera during the past year.

TUBERCULOSIS.

The increasing and alarming frequency of tuberculosis in hogs, as observed in the meat-inspection service during recent years, led to experiments to determine the most probable source of infection of these animals. The practical conclusions of these investigations are that the most frequent causes of tuberculosis in hogs are to be found in the common practises of allowing these animals to follow cattle in the feed lot and of feeding them on skimmed milk or separator refuse. The feces of tuberculous cattle have been found to be heavily charged with tubercle bacilli. The experiments indicate that animals with tuberculous lungs, while they do not expectorate after coughing up tuberculous material, nevertheless scatter the bacilli freely by swallowing them, having them pass thru their intestines, and discharging them with their feces. Hogs readily contract tuberculosis from eating the excrement of tuberculous cattle. For milk to be infected with tubercle bacilli it is not necessary that the udder should be diseased; infected feces are believed to be a common cause of contamination of milk drawn in the environment of tuberculous cows. Thus it seems that a single diseased cow may be the means of infecting the milk of an entire herd.

Other experiments showed that the location of lesions in the bodies of animals affected with tuberculosis is no guide to the mode or channel of infection. For instance, lesions in the lungs have usually heretofore been regarded as indicating that the infection was acquired by inhalation. The incorrectness of this view was shown by producing lung disease by inoculating hogs in the tip of the tail and by feeding them with tuberculous material.

These results emphasize anew the great importance of every farmer keeping his herd free from tuberculosis.

Experiments in the application of the tuberculin test to hogs showed that when proper precautions are taken tuberculin is about as accurate in detecting tuberculosis in hogs as in the case of cattle. The test was found reliable in 97 per cent of the infected experimental animals.

HOG CHOLERA.

Hog cholera has long been a cause of heavy loss to the farmers, and for years scientists in the Department and in various parts of the world have been working on the problem of the cause and prevention

of this disease. Recent work of the Bureau of Animal Industry has demonstrated that the contagion consists of a virus which exists in the blood and other fluids of diseased animals, but which can pass thru the finest filter, is invisible under the microscope, and therefore can not be isolated or discerned by any of the usual methods. This important discovery, which has since been confirmed by eminent scientific authorities in England and on the Continent of Europe, affords an explanation of the failure of past efforts to produce a satisfactory vaccine.

The real cause of the disease having at last been determined, the Bureau has during the past season conducted experiments with a view to producing a vaccine or serum which will prevent or cure the disease. Successful results have already been obtained in an experimental way, and efforts are now being made to adapt the method to practical and general use. The method has been patented by the Department in the name of the scientist who evolved it, Dr. Marion Dorset, the patent having been taken out in such a manner as to insure to all the people in the United States the right to its use free of royalty.

PARASITES OF SHEEP.

The stomach worm or twisted wireworm of sheep, a parasite causing great damage to flocks in many parts of the United States, has been studied, and the principal facts in its life history, which have hitherto been unknown, have been worked out. The eggs of the parasite are scattered over the pastures in the droppings of infested sheep or cattle. The embryos, which in a certain stage are enveloped in a sheath which enables them to withstand freezing and dryness, climb up blades of grass. When infested grass is eaten by a sheep the embryos continue their development in that animal. Experiments now in progress indicate that with certain precautions it is entirely feasible to raise lambs free from this and some other troublesome parasites.

BLACKLEG VACCINE.

The Department has continued to supply blackleg vaccine free of charge to stock owners, and reports indicate that the prevalence of this disease is gradually being reduced. During the year 1,350,915 doses of this vaccine were prepared and distributed. The losses among animals treated with this vaccine during the previous year were less than one-half of 1 per cent.

PEDIGREE ASSOCIATIONS.

After consultation with officers of American pedigree record associations, the Department has radically changed the regulations regarding the importation of animals for breeding purposes. Hitherto certificates of approved domestic and foreign associations have been accepted with the requirement that they should show the ancestors for two generations. This requirement caused inconvenience and dissatisfaction to importers, but the Department felt that unless it could supervise more closely the books of record such a requirement was necessary to give a reasonable assurance of pure breeding. The new regulations simply require that animals imported for breeding purposes shall be registered in an approved American book of record in order to be entitled to free entry. Where a breed has no book of record in the United States the certificate of the Chief of the Bureau

of Animal Industry must be obtained. The records of the approved associations are closely supervised by the Department and must conform to prescribed conditions in order to remain on the approved list. This change should prove beneficial to the breeding industry. It will not only make officers more careful in the management of pedigree registers, but will practically compel the registration of imported pure-bred animals in American books.

HORSE-BREEDING INVESTIGATIONS.

Satisfactory progress is being made in the experiments in breeding heavy harness horses at the Colorado Experiment Station. The stud has been increased by the purchase of two Kentucky mares of desirable strains of breeding. It is considered advisable to increase further the number of experimental animals, and the Department should be prepared to purchase exceptionally good mares as opportunity offers. This line of experiments promises to be of the greatest value to American stockmen and should be carried out systematically and thoroly.

Experiments have been begun, in cooperation with the Vermont Experiment Station, in breeding Morgan horses with the object of preventing the loss of the Morgan blood, preserving the type, and increasing the size. Seven mares and two fillies were purchased in Vermont and two mares in Kentucky for these experiments.

FECUNDITY OF SOWS.

Some unexpected but instructive results were obtained by a study of the fecundity of Poland-China sows. It had been supposed that this breed of hogs was declining in fecundity, and the Department was urged to undertake experiments with a view to overcoming this tendency. An investigation into the pedigree records and a comparison of two periods of years, based upon nearly 55,000 litters, showed that the average number of pigs per litter was 7.04 during the years 1882–1886, and 7.52 during 1898–1902. There was thus an increase of 0.48 per litter instead of a decrease. These results led to a similar investigation of the Duroc-Jersey breed, and while the popular supposition that this breed is more prolific than the Poland-China was confirmed, it appeared that the average size of litters of Duroc-Jerseys had remained practically stationary for several years, the figures being 9.22 for 1893–1897 and 9.27 for 1898–1902. These investigations are being followed with studies of the inheritance of fecundity.

POULTRY BREEDING.

Investigations, with a view to developing a strain of chickens with increased egg-laying capacity, are being conducted in cooperation with the Maine Experiment Station. Several hens have been found to lay more than 200 eggs in one year, and the results seem to indicate that by selecting the best layers for breeding purposes and by proper feeding the average egg yield of a flock can be increased. The great benefit of such an increase is too obvious to require comment.

EXPERIMENTS IN ANIMAL NUTRITION.

A careful scientific study of the fundamental principles of animal nutrition by means of a respiration calorimeter has been in progress for several years at the Pennsylvania Experiment Station by cooperation between the Department and that station, and some important

and valuable results have been realized. Beginning with the food as a source of energy to the animal machine, the investigators follow this energy thru to its ultimate effect, determining how much escapes in the undigested residues of the food, how much is expended in the digestion and assimilation of the food, and what surplus remains to sustain the life of the animal or to enable it to produce meat, milk, or work.

The results thus far published include experiments with timothy hay, red clover hay, and corn meal, and they have shown that the so-called "fuel value" of feeding stuffs can not be taken as a measure of their nutritive value. The experiments have amply demonstrated that the real nutritive values of stock feeds are much less than their fuel values, the former ranging from 56 to 67 per cent of the latter in the particular feeds used. Experiments to study the effect of age and breed upon the percentage of food energy utilized have not been concluded.

FEEDING COTTON-SEED PRODUCTS TO HOGS.

The Bureau of Animal Industry has conducted experiments during the year to test the harmful properties of cotton seed and cotton-seed meal when fed to hogs. These substances proved fatal to the hogs, the time required to cause death being longer when a varied ration was fed than when only one kind of grain was fed in addition to the cotton-seed meal. The results obtained by experiment stations as to the fatal effects of cotton-seed products in combination with corn meal were confirmed, but it appears from the Department's experiments that bran and middlings, instead of neutralizing the injurious effect of the cotton seed, as had been concluded from experiment station work, gave results very little better than corn meal. The experiments with bran and middlings will be repeated and other tests made. Chemical and pathological studies are being made with a view to discovering the cause of the harmful effects of cotton seed when fed to hogs.

THE DAIRY INDUSTRY.

The work of the Dairy Division of the Bureau of Animal Industry has been considerably extended during the year. Results of a valuable and practical nature to the dairy industry have been obtained from investigations in the manufacture and storage of butter and cheese and the production and delivery of market milk; and a good beginning has been made in the work for the improvement and development of dairying in the South and the investigations and studies regarding the construction of dairy buildings and the organization and management of dairy enterprises.

BUTTER INVESTIGATIONS.

About 5,000 pounds of butter were made under different conditions and stored for eight months at different temperatures. The conclusion from this experiment is that the use of cream received at the creamery in a sweet condition, light salting of the butter, and low temperatures (10° F. below zero to 10° F. above zero) give much the best results for storage butter.

Two common troubles of butter makers—mold in butter tubs and the fishy flavor of butter—have been studied. The coating of tubs with paraffin has been found to be an effective method of preventing mold. Investigations regarding the fishy flavor have not progressed far enough to determine the cause of this trouble and are being continued.

A system of market inspection of butter at New York and Chicago has been started with a view to assisting creameries to improve the quality of their product. When butter arriving at one of these markets is found deficient in quality a statement of its condition is sent to the butter maker, to the dealer who purchases the butter, and to the dairy and food commissioner of the State in which the butter was produced.

CHEESE INVESTIGATIONS.

Further work was done during the year in the manufacture and storage of cheese. A quantity of American Cheddar style cheese was made, cured, and stored under varying conditions, and the details of the experiments, with a review of previous work on the subject, were published. The cheese that scored highest was that placed in storage at 32° F. directly from the press, while that scoring lowest was cured entirely in the factory curing-room at about 65° F. Cold curing appears to derive its value chiefly from its effect on what otherwise might be poor cheese. The popular taste is growing decidedly toward mild cheese, and to meet this demand it seems desirable to have cheese ripened, so far as it is ripened at all, at low temperatures.

The experiments in the manufacture of soft cheese of leading European varieties have been continued thruout the year in cooperation with the Storrs (Conn.) Experiment Station. During the winter a scientist connected with this work spent two months in Europe studying the manufacture of cheese, and these studies have resulted in marked progress in our investigations regarding Camembert and Roquefort cheese. While there are some problems yet to be investigated, the knowledge so far gained of the fungi, methods, and conditions necessary in the production of these kinds of cheese indicates that it is entirely practicable to manufacture in this country soft cheeses of these types fully equal to the best European product.

THE PRODUCTION AND HANDLING OF MILK.

Probably no article of food is more generally consumed than milk, and in striving for pure foods a wholesome milk supply must be considered of prime importance. During the year the Dairy Division has investigated the milk supplies of various cities, and has begun studies of the organization and working of milk sanitary commissions and other bodies whose object is to improve the quality of market milk.

The competitive exhibit of milk and cream at the National Dairy Show in Chicago in February was in charge of the Dairy Division and gave an object lesson of great educational value. It was demonstrated that milk and cream produced under sanitary conditions could be shipped long distances and kept sweet for several weeks without any other means of preservation than cleanliness and low temperatures.

DAIRY IMPROVEMENT IN THE SOUTH.

A careful survey of dairy conditions in the South has been made as the first step in the work of improving these conditions and promoting the dairy interests of that section. This preliminary work has shown that while in some cases southern dairy herds are yielding as good results as are ordinarily expected in any part of the country, there is great need thruout the South for education in improved methods of dairy breeding and feeding and milk production. Many of the south-

ern people show a desire to learn more of dairying so as to get away from the one-crop system. One serious handicap is the inferior class of cattle found there, probably due largely to the presence of the cattle tick.

OTHER DAIRY WORK.

To meet the demand for information and assistance as to the construction of dairy buildings, some studies and experiments have been and are being made. A circular giving plans for an improved dairy barn was published, and many plans for dairy buildings of various kinds have been worked out and sent to farmers thruout the country. Some experiments have been made in building silos of three types of construction.

Investigations into the organization, equipment, and management of creameries and cheese factories have been undertaken to enable the Department to give advice and assistance on these subjects.

RENOVATED BUTTER.

In the administration of the portion of the law of May 9, 1902, which relates to renovated butter, the Department has continued its supervision of the manufacture and sale of this article. The factories and ingredients are inspected to insure sanitary conditions and wholesomeness, and the product is inspected in the markets with a view to detecting and preventing violations of the law and regulations as to proper labeling. The factories are in better sanitary condition than in past years, and as a rule the manufacturers show a disposition to comply with the law and regulations. Evidence of the illegal sale of renovated butter by dealers in several cities has been collected, however, and some prosecutions have been instituted. The regulations of the Department have been sustained in two court decisions.

BUREAU OF PLANT INDUSTRY.

A leading feature of the work of the Bureau of Plant Industry during the past year has been the cooperative demonstration work with farmers, fruit growers, and others. It has been my established policy to have our own officers carefully scrutinize all operations, including those which involve the conducting of business as well as those in which both field and scientific investigations are concerned.

INTRODUCING NEW CROPS AND NEW INDUSTRIES.

The search by agricultural explorers in foreign lands for new crops has been continued. A trained man has spent the last year in the cultivated fields and wild mountains of north China and Manchuria searching for new plants and seeds worthy to be transplanted to this country and for wild forms of our cultivated fruits and vegetables which may have characters of hardiness or unusual vigor that will make them useful for the plant breeders of the United States. Shipments of scions and of seeds representing hundreds of interesting things have been sent in and are now growing in the trial gardens of the Department. Among the things secured are new hardy Pekin persimmon varieties, interesting varieties of the English walnut, the Chinese pistache, wild and cultivated apricots, the wild peach from its supposed original home, hardy apples and edible-fruited hawthorns, millets and field beans, a lawn sedge that is promising, and a very remarkable lot of Chinese grape varieties, not to mention a most

unusually interesting collection of ornamental trees and shrubs suited to the climate of the Eastern and Middle States.

NEW ALFALFAS AND OTHER CROPS.—One of the most important achievements of the Bureau's exploration work is the recent discovery by Prof. N. E. Hansen, of the South Dakota Agricultural Experiment Station, who is now abroad in the interest of the Department, of the existence of a Siberian alfalfa, an excellent forage plant with yellow instead of the usual blue flowers. This plant is native on the dry steppes of Siberia, where the mercury sometimes freezes without snow, thus proving the ability of the plant to withstand with no protection a temperature of about 40 degrees below zero. The existence of this alfalfa has been suspected for many years, and its final discovery, it is believed, may mark an epoch in the agriculture of the northwestern prairie regions of the United States, where the rainfall is slight and the winters are exceedingly cold. Professor Hansen is making a very careful study of this plant, with a view to its cultivation in this country. A quantity of the seed of this valuable crop has been secured, which will be given a thoro trial by the Department at an early date. It will supplement durum wheat in a rotative system and avoid the necessity of summer fallowing.

The most distinct of any of the alfalfas is the newly introduced Arabian, characterized by its large leaflets, hairiness, and vigorous growth. Its quick recovery after cutting renders an extra cutting possible in long seasons. It is proving of special value in the irrigated sections of California and the Southwest, tho its lack of hardiness makes it unsuited to the colder parts of the country. Attempts are under way to establish strains resistant to cold and drought.

A species of vetch called the Tangier pea has proved superior to all others in California in its luxuriance of growth, having yielded as high as 9 tons of green feed per acre. On account of this great amount of herbage it chokes out weeds very effectually. As a green manure crop it promises in California to supersede all others. Its value as forage remains to be ascertained. A large quantity of seed is being grown so as to introduce it extensively next season.

A most luxuriant subtropical grass, called the Para grass, has proved well adapted to the Gulf coast region, Arizona, and California. Where sufficient moisture is provided this grass will yield about 8 tons of hay per acre. It is coarse in quality, but very nutritious. The seed is very poor in quality, but the grass can readily be grown from cuttings, one plant covering 100 square feet or more in a season. It is planned to distribute the cuttings extensively in the spring of 1907.

ENCOURAGING THE MATTING INDUSTRY.—The United States imports every year larger and larger quantities of hand-made floor coverings made from several species of aquatic rushes and sedges that grow pretty generally over the world. In 1906 more than 50,000,000 yards were imported, and more than $4,000,000 paid for them, notwithstanding the fact that looms have been invented that can weave the rushes into useful floor mats. These looms, the result of American ingenuity, when tended by single operators, can turn out more than 30 yards of matting a day—a strong contrast to the hand looms in use in foreign countries from which we draw our supplies of matting. The common rushes of our neglected swamp lands and tidal regions can be made into matting, but these lack the delicate, slender character of the cultivated forms in use in the Orient, India, and Africa. Our explorers have been gathering living plants of the best foreign

varieties, as well as selecting the most promising native types for trial plantings in the abandoned rice plantations of the Carolinas and for the delta regions of the Mississippi and Rio Grande, where cheap lands, which are not now growing profitable crops, are awaiting for a new plant culture.

A NEW SUBTROPICAL FRUIT.—The Florida fruit growers have had their enthusiasm aroused this year by the ripening of several of the delicious, fiberless East Indian mangoes which the Department has introduced. The collection is one of the largest in the world and Florida growers are waiting to see the behavior of the different sorts now under trial before planting large areas in this fruit, without doubt one of the great fruits of the world.

SUCCESSFUL DATE CULTURE.—The date palms introduced by the Department into southern California and Arizona have borne hundreds of pounds of delicious fruit this year. Even the famous Deglet Noor from the Sahara has ripened perfectly in the Salton Basin, proving that this unique desert culture has past from the stage of a pure experiment into that of a new industry.

THE PISTACHE NUT.—The investigation of the pistache, a promising dry-land nut crop, has resulted in a distinct widening of the possibilities of its culture thru the introduction from Turkestan of hardy forms. Three wild species suitable for stocks have been introduced from the driest deserts of the Old World, and a very hardy stock has also been secured in northern China.

INVESTIGATIONS BY THE PATHOLOGISTS.

The year has been an unusual one in the field of plant pathology. There have been serious outbreaks of disease and the staff of men engaged in this work has been kept very busy.

PEAR BLIGHT.—The Department has worked out by careful bacteriological investigation methods of controlling this serious menace to the pear and apple industry. The disastrous attacks of the old eastern pear blight upon the magnificent pear orchards of California have brought into prominence the importance of this work. During the past six years the Department has been engaged in demonstrating on a small scale in certain isolated orchards the practicability of controlling the disease, mainly by the eradication of the blighted portions of the tree and the antiseptic treatment of the wounds. Strenuous efforts are being made by the Department, in cooperation with the State experiment station and the State and county horticultural commissioners of California, to assist in applying these methods in saving the California orchards. The pear orchards of California represent a valuation of about $15,000,000, producing an average annual income to the fruit growers of $1,500,000. One-third of this, at least, has already been destroyed, but we hope to help the growers to save the remainder. Pear blight is destroying the pear industry in several other western States, and urgent requests have been made for assistance, which the Department expects to grant as far as it is able.

LITTLE PEACH AND PEACH YELLOWS.—The little peach disease has now been kept under control for three years on the test area in Michigan, and it is believed that the efficacy of the method has been fully demonstrated there. Work has therefore been transferred to a similar demonstration, in cooperation with the Cornell Experiment Station, in a test area in Niagara County, N. Y. This is confidently

expected to show the possibility of greatly reducing the ravages of the little peach disease and also of the peach yellows.

Peach yellows has been unusually destructive in West Virginia and Maryland during the past season. Department experts have been studying the disease in cooperation with the West Virginia State Experiment Station and urging the application of eradication methods. In one district, at least, in West Virginia, fully 90 per cent of the peach trees have been destroyed by the yellows during the past three years, and mainly during the present season.

Apple bitter rot in the Ozark Mountain region.—Last season's successful spraying experiments in Virginia demonstrated for the first time the possibility of controlling bitter rot of the apple on the Yellow Newtown variety and indicated the exact dates of treatment. This work has now been transferred to the Ozark districts of Missouri and Arkansas. Here it has been tested on a much larger scale and on different varieties of apples. The results fully corroborate last year's conclusions and have demonstrated the entire feasibility of practically complete control of this serious orchard disease. Some minor rots and defects of the apple have also been more completely brought under control as a result of this treatment.

Gumming fungus or shot-hole fungus of the peach.—The gumming fungus or shot-hole fungus has been increasing in California at an alarming rate during the last five or six years and has resulted in very severe losses to the peach growers of that State. It threatens the destruction of the peach industry of the Sacramento and San Joaquin valleys. A treatment was suggested, after proper study by Department officials, which has been wholly successful.

Wilt-resistant melons.—Wilt has nearly destroyed the watermelon industry in many sections of the South. All known varieties of melons have been tested, but none resistant to the disease was found. It was found, however, that the citron is resistant, and the Department undertook by hybridization to breed this quality into the melon. The result has been successful, and there has been secured and fixt a variety of melon very resistant to wilt—a heavy yielder, of excellent quality, and well adapted to shipping. Next season it will be propagated for distribution.

Wilt-resistant cotton.—The wilt-resistant selections of Sea Island cottons are now regularly used in the infected soils in the Sea Island districts of South Carolina. The loss from this disease has thus been practically eliminated in the principal region in which this special cotton is grown. The disease is still causing much loss in the interior districts, where this variety of cotton is grown, owing to the fact that many of the growers do not appreciate the value of resistant seed. Demonstration tests, however, are rapidly convincing them. Excellent wilt-resistant selections of Upland varieties have also been secured. Seed will be distributed this year to cooperators and propagated next year for more general distribution.

Disease-resistant potatoes.—For several years this Department has been testing various American and European varieties of potatoes, especially for disease resistance, and has now secured several good varieties resistant to both the early and late blight, as well as to tip-burn and flea beetles. The work is carried on principally in cooperation with the Vermont Experiment Station, tho several other States are also cooperating.

PROGRESS IN CEREAL WORK.

EXTENSION OF THE WINTER WHEAT AREA.—About four years ago the Department began a systematic distribution of the Kharkof wheat, and extensive trials of this variety in cooperation with the State experiment stations. It is the hardiest winter wheat yet grown in this country, and is now thoroly established. By its use the area in which winter wheat can be successfully cultivated has been much extended to the northward and westward, particularly in Nebraska and Iowa, while a considerable amount is now grown in South Dakota and southern Minnesota. It will be conservative to state that wherever this wheat has been introduced the yield per acre is being increased on an average of 5 bushels.

ESTABLISHMENT OF WINTER BARLEY.—Much attention has been given this year to the introduction and development of winter varieties of barley. It is well known that fall-sown grain will yield much more on the same ground than spring-sown grain, in addition to the fact that winter grain is almost always of better quality. Excepting some Southern States, winter barley has heretofore been practically unknown in this country. After three years of demonstration work, the Tennessee Winter barley is now well established in Kansas, Oklahoma, and southern Nebraska, in addition to a few successful trials that have been made in the North Central States. The results of the introduction of this barley are remarkable and very interesting. Wherever it has been grown it is now often yielding 50 per cent more to the acre than the ordinary spring barley. Besides, it has the advantage of giving much winter pasturage in seasons that are favorable for pasturing.

The unusual success of some of our introduced Swedish and Austrian pedigreed barleys is opening up the great possibilities of pure strains of this cereal, especially for malting purposes.

DURUM WHEAT.—In the field work on durum wheat all efforts are now being concentrated on its improvement, particularly in the development first of pure types. Much help is being given in the investigations of this wheat by the experiment stations, particularly those of North Dakota, South Dakota, and Colorado. It is so well demonstrated that the Kubanka variety is the best, considering all qualities, for the northern districts that farmers everywhere thruout the North are urged to sow only this type. A number of experiments, including baking tests, all of which have been published, have proved conclusively that it is equal to the best No. 1 hard spring wheat for making bread. The results in the sale of this wheat during the last season and so far this season have been favorable far beyond expectation. Last year about 10,000,000 bushels were exported to foreign countries, and the price on an export basis at New York City and on the Canadian border was at several times equal to that of the hard spring wheat. Probably at least 20,000,000 bushels were produced in 1905, which, after making ample allowance for seed, leaves several million bushels that must have been used for bread in this country. A good portion of this was used in Minneapolis. For the crop this year a safe estimate would be about 50,000,000 bushels, or approximately one-twelfth of the usual wheat crop of this country.

From the daily and weekly reports received from the markets, it appears that about 12,000,000 bushels of this crop have so far been sold for export. This season, at New York City, durum wheat is so

far selling uniformly at 5 or 6 cents less than the same grade of Manitoba hard. The increasing export demand from dealers who know how to judge this class of wheat ought to be strong evidence of its value to American manufacturers, and it is hoped that in the future our home consumption will increase much more rapidly.

Sixty Day oat.—In previous reports attention has been called to the superiority of the introduced Swedish Select oat over other standard varieties thruout the Northern States. During the same time another variety of oats has been introduced from Russia, known as the Sixty Day, but which matures, however, in a little over ninety instead of sixty days. It is so much earlier than other varieties that it often escapes many fungous and insect pests that attack other oats, as well as the effects of severe periods of drought. It is very prolific as a rule, and has an unusually wide adaptation geographically.

Amarillo testing farm.—The testing farm at Amarillo, Tex., has been in operation one year, and the fall seeding of the second year is now finished. The operations here are to a large extent in the nature of pioneer work to demonstrate to the inhabitants of the large area of the Panhandle of Texas that agriculture can actually be conducted in that region. The experiments were conducted previously at Channing, Tex. That much success has been attained in this work is indicated in the many crops that have been successfully grown thruout that territory during the last year, the farmers having been induced to sow these crops largely thru the influence of these investigations.

Investigations in California and the Southwest.—Experiments for the purpose of improving the quality of wheat in California have been conducted for two years at Modesto and Yuba City, Cal. In addition, seed of some of the most promising varieties of wheat used in these experiments has been furnished in cooperative trials with farmers in other States of the Southwest. From the results of the work so far it is evident that at least two of these new wheats are very well adapted to the southwestern United States and are at the same time good milling wheats.

Chemical and baking tests of flour and grain.—In cooperation with the Bureau of Chemistry many chemical analyses and other tests have been made of introduced grains, particularly oats and barleys, to determine their feeding value. An important piece of work has been the investigations of the comparative value of durum-wheat flour for bread making conducted for this Department by the Columbus Laboratories of Chicago.

A study of wheat deterioration.—During the year a special investigation, also in cooperation with the Bureau of Chemistry, has been made to determine the causes of the deterioration of wheat from the milling standpoint. An important clue to the solution of this problem has been discovered, and when the matter is fully worked out it will, without doubt, enable the farmer to prevent the production of soft and light-colored grains that are much inferior in quality.

Rice investigations.—A series of experiments for the thoro study of rice, its varieties, methods of handling, irrigation, etc., has been inaugurated in cooperation with the Louisiana Agricultural Experiment Station, Crowley, La., having been selected as the place of operations. More than 300 distinct varieties of rice are under experiment. The results of this season already show that a good beginning has been made in this work.

GRAIN STANDARDIZATION.

From time to time during the past five years demands have been made upon the Department for aid in the grading and handling of grain. It has been fully recognized that this is a matter which demands most careful investigation, as both our home and foreign markets are involved. Grain grading as now practised by the various State and other organized bodies has not been satisfactory, chiefly on account of the lack of uniformity. The Department has consistently held the ground that some system of standardization is absolutely necessary as a first step toward securing uniform methods of grain grading. With a view to eventually bringing about this standardization, Congress at its last session authorized the establishment of laboratories for the purpose of examining and reporting upon the nature, quality, and condition of any sample, parcel, or consignment of seed or grain entering into interstate or foreign commerce. After a careful study of the situation, two laboratories, all the funds at hand would permit, have been established—one at Baltimore, Md., the other at New Orleans, La. At both places the Department has received the cordial cooperation of the chambers of commerce, and is now about to enter upon the regular duties connected with the laboratories.

It will be the object of these laboratories to make a thoro study of present systems of grain grading with a view to reaching, if practicable, conclusions which will make standardization possible. It is recognized that much preliminary work must be done, and, furthermore, that special apparatus will have to be devised for quickly determining the moisture content of grain, and for conducting other observations and investigations. A moisture-determining apparatus has already been devised and is now in use at our laboratories. It is believed that improvements can be made in these devices and the Department's officers are already at work on this problem.

Recognizing the need for the closest relations with the grain trade, the Department has secured the services of an expert in grain grading, whose long experience should be of the greatest value in working out the many problems which must necessarily be connected with this important line of work.

DRY-LAND FARMING.

Recognizing the necessity for more systematic efforts along the line of dry-land farming, during the past year important field and laboratory investigations have been arranged for, which, it is believed, will be of great value to those who have already settled or who contemplate settling in semiarid areas where irrigation is impracticable. The Great Plains area, lying between the ninety-eighth and one hundred and fourth meridians and including approximately 330,000 square miles, is one of the most important districts where this work is being conducted.

Scope of the investigations.—Thruout this vast area there is not a single State experiment station, altho there are several substations. The plan of the work is to establish special substations in cooperation with the State experiment stations in North Dakota, South Dakota, Nebraska, Oklahoma, Colorado, Kansas, and Texas. At these stations a series of tests will be carried on which will enable the State authorities and the Department to answer definitely important questions as to systems of cropping and farm management in this

extended area. The successful work already inaugurated with the durum wheats leads to the belief that there are several other crops which might also prove highly successful.

ADVICE TO PROSPECTIVE SETTLERS.—On account of the efforts made by land agents for the past two or three years to induce farmers to take up land in this region it seems proper to make a few cautionary statements in regard to this entire section of country. While there are great agricultural possibilities in the region, the fact must not be overlookt that farming there must be conducted along radically different lines from those of the more humid portions of the United States. Unquestionably many settlers have gone into this section who will be grievously disappointed in the near future. In spite of the fact that the past few seasons have given abundant rainfalls, the evidence is pretty conclusive that conditions will soon resume their normal state, which is one of semiaridity, and these conditions must be met in a way for which few farmers of the section are now prepared. It is needful to look with great caution upon the statements emanating from interested parties as to the probability of continued rainfalls and the growing of crops similar to those now commonly known to the more eastern sections of the United States.

GOOD SEED FOR THE FARMER.

Several lines of work carried on during the year have for their object the improvement of the seed upon which the farmer must depend for his crops. The investigations of seed adulterations previously mentioned in these reports have been continued, and there is every evidence that the publication of the names of firms found to be selling adulterated seed has been the means of checking the evil. In all this work the Department has but one object, namely, to protect the farmer from unscrupulous dealers who make a practise of foisting bad seed upon him. The rank and file of American seedsmen do not follow any such practises and are as anxious as the Department to protect the farmer.

A CAMPAIGN OF EDUCATION.—The Seed Laboratory has tested for both seedsmen and farmers hundreds of samples of seeds during the past year, and in this way has greatly encouraged the propaganda for good seed. A feature of the work has been a campaign of education for better seed. Cheap seed is often the most expensive thing connected with a crop. A few cents saved on each pound of alfalfa or clover seed may cost the farmer all of his work in preparing and fertilizing the ground, besides the loss of an entire season in getting the crop started. The Bureau has also been actively engaged in encouraging the good-seed work thru addresses at farmers' institutes and other meetings.

BETTER GRADES OF SEED CORN.—Special work has been done during the past year in demonstrating the great importance of high-grade seed corn. The work was inaugurated to establish the great value of proper care of the ordinary seed as grown by the farmer. The main point at issue was the gain in yield due to the vitality of the seed. Actual field demonstrations have shown that, taking corn in the average—that is, corn from different parts of the United States as ordinarily saved for seed by farmers—the yield would be increased about 15 per cent if the vitality were perfect. The Department has pointed out simple methods of testing vitality that any farmer can follow, and has shown in field practise that the adoption of such methods by the farmer may increase his yield from 10 to 15 per cent. Similar work has been conducted with a number of other crops.

WORK ON THE SUGAR BEET.

PRODUCTION OF HIGH-GRADE STRAINS OF SEED.—The work on breeding high-grade strains of sugar-beet seed has been very satisfactory during the year. This work is being conducted in cooperation with a number of experiment stations and private individuals. The first commercial crop of seed raised from roots selected under departmental supervision was harvested this year by a grower in Washington State and some 15,000 pounds of seed were secured, all from beets which, commercially analyzed by the Department, showed sugar contents of 21 to 22 per cent. In the work of selection rigid attention is given to every detail of size, color, form of root, shape of leaf, etc. The Department has received from a number of sources satisfactory evidence that the American seed which it is developing is highly satisfactory. One factory alone reports that the American-grown seed increased the yield 1.19 tons per acre on an area covering 391 acres, divided among 158 farmers. This seed was put out in competition with some of the most expensive grades of imported seed obtainable. As a line of work closely connected with the foregoing, the Department is carefully investigating and testing various varieties of sugar-beet seed imported, together with all strains of sugar-beet seed grown by American firms.

SINGLE-GERM SEED.—Very satisfactory results have been secured in the development of a sugar-beet seed which will contain a single germ. It is highly important to secure beet seed which will eliminate a considerable portion of the work of thinning. The latest returns from our investigations along this line show that our beets are averaging about 26 per cent of single-germ seed and that such seed is producing beets yielding from 16 to 17 per cent sugar. The purity coefficient is also found to be satisfactory.

The important work on fertilizers, the improvement of cultural conditions, and the extension of the sugar-beet area has been continued.

FRUIT MARKETING, TRANSPORTATION, AND STORAGE INVESTIGATIONS.

Experimental investigations of the methods of harvesting, packing, transporting, and storing fresh fruits of various kinds have been continued during the year. The fruit transportation studies have been confined chiefly to questions involved in the transcontinental shipment of deciduous and citrus fruits of the Pacific coast to eastern markets.

SHIPMENTS OF PEACHES AND PLUMS.—Experimental carload shipments of perishable varieties of peaches and plums, which were allowed to remain on the trees in California until they reached much fuller ripeness than has previously been considered safe by shippers, disclosed the fact that such fruit can be delivered in eastern markets in practically as sound condition as when taken from the tree. The superiority in flavor and wholesomeness of such sound, ripe fruit as compared with fruit either overripe and decayed or prematurely picked and wilted, which makes up so large a portion of the commercial supply of our cities, was clearly apparent. Special treatment of these experimental shipments consisted simply in the quick cooling of the packed fruit from the high temperatures which it possest when picked from the tree to a temperature of 40° to 50° F. before it was loaded in ordinary iced cars for shipment. Carloads of fruit thus treated not only required less ice in transit, but maintained more uniform tempera-

tures in the top and bottom of the car, with resultant greater uniformity of condition of contents when unloaded.

Experiments in citrus fruit transportation.—Along similar lines, but with closer attention to methods of harvesting and manipulating the fruit, a careful study of orange-handling methods in southern California was made. This revealed many interesting and important facts. It was found that the difference in the carrying quality of oranges from different producing districts in southern California was due primarily to the methods of handling practised rather than to inherent characteristics of the fruit itself. Oranges free from mechanical injuries, inflicted during the various processes of harvesting, rarely showed decay during the ordinary shipment period, even when transported without icing. On the contrary, similar fruit which had suffered from inconspicuous cuts or abrasions of the skin developed from 25 to 75 per cent of decay under similar conditions. A comprehensive series of experiments, in which fruit treated by different methods was subjected to conditions favorable to the development of decay, showed that where unmutilated fruit as it came from the tree developed but 1.5 per cent of decay, similar fruit, when dry brushed, showed 4.5 per cent, and washt fruit 10.5 per cent. The whole trend of the results of the investigation thus far indicates that complexity of methods and appliances in the handling of oranges results in increased mechanical injury and correspondingly heavy losses from decay in transit.

A study of the transportation of oranges across the continent, in which different methods of shipment were compared, showed that where oranges that had been mechanically injured were shipped under ventilation, 14 per cent of decay developed. Similar fruit shipped under ordinary icing developed 7 per cent of decay, while fruit that was precooled and shipped in iced cars developed but 4 per cent. Studies of the effect of holding the packed fruit before shipment showed that, on the average, fruit shipped the first day after packing developed but 2 per cent of decay; that shipped the third day, 3.5 per cent; the fifth, 8.6 per cent, and the seventh day, 9.5 per cent. The proportion of decay developed in the mechanically injured fruit included in the above experiments was very much above these general averages, the important fact developed being that prompt shipment after packing greatly reduces the risk in transit.

Results of fruit transportation work.—These investigations have had the active support of growers, shippers, and transportation interests. In the citrus industry advantage is being taken of the results of the work. Packing houses are being remodeled and simplified, the fruit is being shipped more quickly after picking. All the interests involved have shown a disposition to take advantage of the facts developed in the investigations. One of the prominent shipping interests of the Pacific coast has estimated that the work of the Bureau along this line saved the growers at least $250,000 in the season of 1905–6.

Studies of fruit storage.—In the fruit-storage investigations the cooperative study of the effect of sod and tillage on the keeping of apples has been continued with the New York State Agricultural Experiment Station, and special studies in relation to temperatures have been made in the East. The apple-storage investigations have been extended to Pacific coast fruit, considerable quantities of apples

from different California apple districts having been stored in that State and in the East for comparison. Special attention has been given to farm storage-house questions.

EXPORT SHIPMENTS OF FRUITS.—In the fruit-marketing investigations the experimental export shipment of summer apples from Delaware was continued, and similar shipments also of winter varieties from New York and Virginia. The problems connected with the exportation of winter apples to European countries are recognized as of the highest importance in this connection and are being studied as thoroly as the conditions render practicable. The importance of the apple export trade to our domestic fruit industry is shown by the fact that while the crop of 1905 was estimated to be the smallest during the past decade, the portion exported was but 7 per cent less than the average of the previous five years, constituting, as nearly as can be estimated, more than 5 per cent of the estimated total crop. Fuller information as to conditions prevailing in ocean transportation and in foreign markets is greatly needed.

The exportation of eastern-grown "Bartlett" and other early pears, which began with the Department experiments in 1901, shows a gratifying increase, the total exports of pears during the fiscal year being valued at $631,972, the larger part of which exports were of eastern-grown fruit. The beneficial effect of this export movement of pears was very evident in our markets, where good prices prevailed in consequence.

DEVELOPING NEW CROPS BY BREEDING AND SELECTION.

The Bureau's work in developing, by breeding and selection, new types of various crops has been very successful during the past year. A number of new sorts have been secured, some of which have been placed with growers and are now being grown on a large scale.

NEW CITRUS FRUITS.—The production of the new group of fruits, the citranges, or hardy oranges, is one of the most far-reaching and important triumphs which has ever been achieved as a result of carefully planned breeding experiments. Three varieties—the Rusk, Willits, and Morton—have already been named, and trees have been distributed to about 2,000 fruit growers and nurserymen, principally in the Gulf States and in Oregon and Washington. Two other new varieties have been produced, having large fruits similar in appearance to ordinary oranges, and these will be named and distributed in the near future. Both of these varieties are somewhat different from the sorts previously named, and are believed to possess superior merits in certain characters. Both are large, fine-appearing acid fruits, and are very juicy. They will prove valuable, especially for culinary purposes and in the making of acid drinks. Another variety has been secured which has fairly good fruits, and gives promise of utility as a hedge plant and lawn tree. The citranges are of special value for cultivation in regions slightly too cold for the ordinary orange, and can be recommended for planting thruout the Gulf States and in regions of low altitude in Oregon, Washington, Arizona, and New Mexico.

NEW PINEAPPLE VARIETIES.—Three of the new varieties of hybrid pineapples have this year been distributed to a number of good growers, and next year stock of all of the new varieties developed by the Department will be available for distribution. The further experiments in this field have resulted in the discovery of six more new

hybrids which possess qualities that will render them valuable for cultivation. These will be placed with growers at the earliest possible date. All of the new varieties of pineapples are superior in flavor to the ordinary varieties, and many of them have smooth or spineless leaves, a quality of considerable value to the grower. All pineapple growers who have had an opportunity to examine and test these hybrids are imprest with their superior quality and promise.

A NEW EARLY VARIETY OF COTTON.—It has been claimed by entomologists and others studying the control of the cotton boll weevil that varieties of cotton are needed which will mature their entire product very early in the season, in order to permit the crop to be harvested and the stalks destroyed early in the fall. A new early defoliate variety has been produced by an agent of the Department, working in cooperation with the Texas Agricultural Experiment Station, which possesses these qualities in marked degree and which, at the same time, is a productive sort having fairly large bolls. This new variety, the present season, ripened its fruit and matured earlier than any other of the varieties tested in comparison with it, among them being the King, which is probably the earliest variety cultivated. The new variety gives promise of being of great value for planting in boll-weevil infested regions. Several other varieties of cotton selected to secure earliness and productiveness, fitting them for boll-weevil conditions, have been under experimentation, and select seed of two of these sorts, the Edson and Triumph, will be distributed this winter.

NEW STRAINS OF CORN.—In the corn-breeding experiments great advances have been made. One variety, which has been carefully bred in central Ohio, has, for the last four years, shown an average yearly gain of 10 bushels per acre over the original variety. Seed of this variety has been sent to numerous farmers and is giving excellent results. The breeding work with sweet corn, having as its object the improvement of strains for canning purposes, has been continued with good success. It has been demonstrated that an excellent quality of sweet corn seed can be grown, and that with good care it will germinate much better and produce a better crop than such seed as is customarily purchased by canning companies.

IMPROVEMENT OF OATS.—The most promising features of the oat-breeding work are the new hybrids recently developed. These are large grained and early in season, and retain the vigor and size of the late-season parent. They bid fair to excel and eventually succeed all the early varieties now grown in the central Mississippi region. Selections for disease resistance have also been made, and the year's experiments have proved that it is possible to secure smut-resistant varieties. One selection of the Burt variety has proved to be almost smut proof.

CROPS RESISTANT TO ALKALI AND DROUGHT.—The testing of different varieties of the leading field crops with regard to their alkali resistance is being continued and extended. Much information that will permit of a choice of crop plants and plant varieties for alkali lands and provide a solid basis for the increase of resistance by breeding has been obtained. The field investigations of crop plants in relation to alkali are being supplemented by extensive laboratory experiments. As a part of the investigations of the Bureau in dry-land agriculture, the breeding of drought-resistant strains of important field crops has been taken up in cooperation with some of the State experiment stations.

PROGRESS IN TOBACCO WORK.

The tobacco-breeding experiments have proved particularly successful, and several of the new sorts produced in the course of the Department's experiments have already been planted extensively by tobacco growers, and are giving excellent results in increased yields of a superior grade of tobacco.

CONNECTICUT WRAPPER TOBACCOS.—In the work of improving Connecticut wrapper tobaccos two new hybrids have been produced—the Brewer and the Cooley. The Brewer is a hybrid of the native Connecticut Broadleaf with the imported Cuban, while the Cooley is a hybrid of the native Connecticut Havana Seed variety with the Imported Sumatra. In the hybrids the good qualities, hardiness, and adaptability to Connecticut conditions of the native varieties are combined with the superior wrapper qualities of the imported Cuban and Sumatra. The product of the hybrids has superior qualities for cigar-wrapper purposes, possessing characters which go to make up a valuable wrapper tobacco. Numerous growers have been pleased with the superior grade of tobacco produced by these hybrids and are this year growing a considerable quantity of the new varieties and selecting seed to extend their planting next year.

WRAPPER AND FILLER TOBACCOS IN THE SOUTH.—The experiments conducted in Florida in the improvement of tobacco varieties have demonstrated the value of this work to growers. Carefully selected strains of Sumatra have clearly shown their superiority, both in quality and yielding capacity, to the ordinary Sumatra-grown. The crops grown from select seed furnished by the Department to 12 different planters are far superior to the remainder of their crops and are decidedly the best crops of tobacco in the State. As a result of this demonstration of the value of the methods of selection and preservation of seed worked out by the Department of Agriculture, almost all of the large tobacco growers are this year using similar methods, and more than 50,000 paper bags have been used during the past summer by growers in covering the flower clusters of their select seed plants.

MARYLAND SMOKING TOBACCOS.—Experiments in the improvement of the Maryland smoking tobaccos have been carried on during the year in cooperation with the Maryland Agricultural Experiment Station. Selections made to secure greater uniformity and increased yields have shown striking results. The fields of tobacco grown from select seed are believed to be the best tobacco grown in the State the present season.

MISCELLANEOUS TOBACCO WORK.—One of the most important features of the tobacco-breeding investigations is the development of methods by which the grade and quality of the tobacco produced can be accurately determined. During the last year an apparatus has been devised for testing the burn of cigars accurately and another for testing the burn of strips of leaves. These machines will prove of great value in connection with the breeding experiments and probably also in the commercial testing of samples of wrapper tobacco. Investigations of the curing of tobacco have been undertaken, directed more especially toward the control of pole burn by means of artificial heat. Several diseases of tobacco are receiving attention, and the breeding of varieties for disease resistance gives promise of good results.

EXTENSION OF EXPERIMENTS.—The tobacco-breeding experiments are being extended to the tobacco-producing areas of Kentucky, Ohio,

and Virginia, and it is probable that results can be obtained in these regions as important as those produced in Connecticut and Florida. The introduction of the methods of seed selection and seed separation alone in these extensive tobacco-producing States will add many thousands of dollars to the value of the crop grown.

DRUG AND POISONOUS PLANT INVESTIGATIONS.

Work on camphor.—Rapid progress has been made in the investigation of camphor production, a number of camphor trees of various ages having been placed at the disposal of the Department for experimental work. More than 30 pounds of camphor were prepared, which on purification gave very favorable results. Tests of a scientific nature showed the identity of this product with that of the Orient. A careful survey of the camphor trees now widely scattered thruout Florida, and of the conditions of soil, drainage, etc., in which they occur, has made it seem reasonably clear that camphor will flourish over a large part of the area from which frost has driven the orange industry.

Studies of poisonous plants.—In the poisonous-plant investigations chief attention has been given during the year to the poisonous action of the so-called loco weeds in causing the loco disease in horses and cattle. The general outcome of this work has shown very clearly that these weeds are able to produce the symptoms characteristic of locoism and are unquestionably the chief cause of the immense loss to the stock-grazing interests of the West. Remedial measures are now being sought, as are also means of exterminating the weeds and methods of counteracting the poison.

PROGRESS IN GROWING AMERICAN TEA.

The work in South Carolina for the purpose of determining the possibilities of the commercial production of tea in the United States has progressed satisfactorily during the year. The younger gardens have given an increased yield, due in part to a change in the method of picking which was tested during the year. As a result of all influences the greatest yield during the history of the experiments was obtained, something over 12,000 pounds of dry tea. In the factory some new machinery was tested. The compression of finely ground tea into tablets was attempted with a machine of the same general type as that used by manufacturing chemists, the result being that after a few trials a hard, sightly tablet was produced which readily dissolves in hot water. The superior adaptability of this form of preparation for purposes where compactness is desired is apparent. In addition to the work in South Carolina a tea garden has been established at Pierce, Tex. The work at this point gives promise of very satisfactory results.

IMPROVEMENTS IN DISTRIBUTING NITROGEN-FIXING BACTERIA.

The method of distributing cultures dried on cotton for the inoculation of leguminous crops was discontinued during the year, and in its place the plan adopted of distributing pure liquid cultures hermetically sealed in glass tubes. This has been proved to be a great improvement over the old system. It is planned to distribute during the current year larger cultures to the farmers, and thus render it possible to reduce the time formerly required to develop a rich culture for inoculating leguminous crops. Many field tests in this work are

under way on large farms, and it is hoped by this careful experimental work to acquire much valuable information concerning the best manner of treatment of certain soils and crops in order to obtain successful inoculations.

WORK ON WATER CONTAMINATION.

The work of the Bureau of Plant Industry in the treatment of water supplies with copper sulfate for the destruction of algæ and pathogenic bacteria has past from the experimental stage to that of actual practical use. Investigations of the use of copper sulfate in sewage disposal have indicated that in small sewage plants the use of copper will make it possible to produce sewage effluents that are entirely free from pathogenic bacteria. Work is being planned to test the efficiency of copper in connection with filtration. Additional work is to be carried on thruout the United States in order to determine the value of copper in various types of water. The copper treatment of water supplies, sewage disposal, etc., should in all cases be supervised by an expert. Before this method of purification is attempted the conditions must be worked out on a scientific basis in each instance.

FARM-MANAGEMENT INVESTIGATIONS.

The farm-management investigations during the past year have been carried on along two principal lines, namely, the study of farm practise and demonstrations in improved methods. The object of the first is to make a careful study of farm methods as followed by successful men in different sections of the country and representing different types of agriculture. These studies lead to the securing of data which enable the Department to assist farmers and others in planning methods of cropping and maintaining soil fertility. In connection with this work special attention has been given to crops adapted to new sections and to the relation between certain improved crops and soil fertility. Alfalfa has been found to be adapted to an important soil formation in Alabama and Mississippi, and is rapidly becoming a valuable crop of that section. This soil is heavily charged with lime. In this connection the Bureau of Plant Industry follows closely the work of the Bureau of Soils in its soil mapping. A special study has been made during the year of the practises of farmers in the East who have been successful in growing alfalfa.

Methods of storing silage.—In connection with the studies of farm practise, a special investigation has been made during the year of methods of storing silage. The kinds of crops used for silage, the cost of growing and of siloing them have all been considered.

Control of Johnson grass.—The farm-management investigations also deal with the question of weed control. It is believed that data have been secured which will enable the farmer to control Johnson grass and utilize it in a satisfactory way in crop rotation in the South. The secret of success in this work lies in the fact that in a Johnson grass sod left undisturbed for two or three years the rootstocks are found only at the surface. In this condition the pest is easily destroyed by shallow plowing and a little extra cultivation the next summer. This permits Johnson grass to be grown in a rotation, such as cotton, corn and cowpeas, winter oats, and Johnson grass for two years. Where the pest is allowed to grow on land that is cultivated in cotton

or corn the rootstocks penetrate deeply into the soil and eradication is extremely difficult.

Cactus-feeding experiments.—Investigations into the value of cactus as food for cattle have been continued. A carload of steers were fattened on cactus and cotton-seed meal, at a cost of 3½ cents per pound of gain. As a feed for dairy cows 6 pounds of fresh cactus equaled 1 pound of sorghum hay when fed with a mixture of grain and mill stuff.

Object-lesson farms.—The object-lesson farms referred to in former reports have been continued. As the result of the work on one of these farms, many farmers in Alabama have sown alfalfa and are thus preparing for the advent of the boll weevil. The great advantage of pasturing hogs on alfalfa in that section has been demonstrated. In order to meet the demand for object-lesson farms in the South the system of establishing these farms has been changed. Instead of assuming close supervision of the farms, working plans are now prepared. This enables the Department to reach many more localities than were possible under the former system.

Nearly all successful farms are unique in their management. They represent systems wrought out by men of unusual energy and intelligence who have gone resolutely about discovering and utilizing the full possibilities of their land. From such men we are learning facts which when properly classified will constitute the art of farm management. These farms demonstrate the great value of intelligent management, as compared with hard work applied unintelligently.

SPECIAL WORK ON COTTON.

The special work on cotton which has for its object the meeting of the ravages of the boll weevil in the South has been continued along pretty nearly the same lines set forth in my last report. The cooperative work with farmers has been a special feature and has been extended into Louisiana, Mississippi, and Arkansas. This work is now carried on in the States mentioned, and in addition special attention has been devoted to Texas, which is in the heart of the boll-weevil infested territory. Experience has enabled the Bureau of Plant Industry to systematize the work so as to reach practical farmers and secure their interest and cooperation. It is estimated that thru this work the Department is now reaching, directly and indirectly, in the neighborhood of 100,000 farmers in the States mentioned.

The plan is a simple one, and from its very simplicity is found to be effective. Meetings of farmers are held in different communities and arrangements made whereby representative men agree to handle a part or all of their land with the advice and assistance of the Department's agents. No radical recommendations are made in the matter of changing the existing systems, unless such systems are known to be bad. The varieties of cotton known to be best adapted for boll-weevil conditions are recommended and planted. Systems of fertilization are suggested and, wherever practicable, diversification is encouraged. The farmers who are cooperating with the Department in the work receive regular visits from our agents and, in addition, furnish weekly reports setting forth their operations and the results. At the end of the season there is, as a rule, a demonstration as to the effectiveness and value of the systems laid out as compared with the old methods. A special point which the Department makes in all this work is that no radically new methods are being urged. We

simply endeavor to have put into practise methods which are already known to be highly successful, encouraging the farmer himself to take the leading part in the work.

The breeding work, having for its object the securing of types of cotton better adapted to boll-weevil conditions, has already been referred to under the head of plant-breeding investigations. As a part of this special work on cotton, investigations of root rot have been continued, the same being largely field studies to determine the value of crop rotations in eradicating the pest from the soil. Investigations of cottons found in Guatemala and other southern countries have also been continued and some interesting results secured. Some of these cottons give promise of proving valuable for use in connection with breeding work. Having developed for a long series of years in combat with the boll weevil, they have characteristics quite different from any types of cottons which we now possess.

DEPARTMENT GROUNDS AND ARLINGTON FARM.

The Department grounds, consisting of 40 acres, are now in a well-developed state. During the year all the roads have been improved, a special appropriation of $3,500 being used for the purpose. The glass houses on the grounds have been further improved and are now being used for many lines of work carried on by the Bureau.

At the Arlington Experimental Farm there are about 350 acres under cultivation. Many varied lines of work are being carried on, including the testing of foreign crops, variety tests of all seeds and plants sent out, cover crops for orchards, variety orchard and other fruit tests, etc. The farm now has a well-equipped range of glass houses for experimental work and all the newer portions of the land are being brought into good tilth by the use of proper management and green manures.

CONGRESSIONAL SEED DISTRIBUTION.

The Congressional seed work for the year has been conducted along practically the same lines as in the past. The number of packages of miscellaneous vegetable and flower seed sent out during the year was about 7,000,000. There has been no change in this number during the past five years.

FIELD LABORATORIES AND TESTING GARDENS.

At its Mississippi Valley laboratory, located at St. Louis, Mo., the Bureau of Plant Industry has conducted investigations of many of the diseases which affect forest and fruit trees in that region. Methods of treating fence posts have also been worked out during the year. Considerable attention has been given to the crown-gall disease of orchard and other fruits, with the object of finding a means for preventing the further spread of the disease. The results obtained have shown that the crown gall of the apple tree can be very largely prevented by careful attention to root grafting and by subsequent wrapping of the grafts with cloth, rubber, or paper. It has been found that this type of the disease is not contagious, while, on the other hand, the crown gall of the grape may be transmitted thru the soil and may be spread by irrigation water from one vineyard to another. American varieties of grapes have been found to be very resistant to the disease, and the most probable method of its control will consist in the grow-

ing of resistant varieties. Further proof has been obtained as to the contagious nature of the crown-gall disease of stone fruits.

In the work on various diseases of forest trees, an investigation of the diseases of red gum has been continued at various points in the Mississippi Valley. The diseases of the living tree were investigated, particularly the form of rot which destroys thousands of feet of gum timber every year after it is cut. A large quantity of timber was given a treatment as a preliminary test to ascertain whether this destruction could be prevented. The treatment showed an increase of 20 per cent in the amount of lumber cut, meaning almost a total prevention. The methods of treatment worked out are being tried by lumbermen on a commercial scale.

At the Subtropical Laboratory, Miami, Fla., the Bureau is conducting investigations of the diseases affecting tropical and subtropical plants, such as the mango, avocado, and citrus fruits. Methods have been worked out for the control of these troubles. Experiments in the propagation of tropical and subtropical fruits are also being conducted at this laboratory.

The Bureau of Plant Industry is carrying on at its Plant Introduction Garden, located at Chico, Cal., experiments in the propagation of many seeds and plants introduced from foreign countries. Trials of forage crops and vegetables suited to the Southwest are also being conducted at this garden. Twelve acres at the garden have been set aside for experimental work on European grape varieties, 4,180 cuttings having been rooted during the past season. A number of these were distributed during the past spring among the experimental vineyards maintained by the Bureau in different parts of California. Experimental work in the propagation of figs and of the pistache nut is also being carried on at the garden and with growers in the Southwestern States.

In addition to the foregoing, the Bureau is conducting an experimental farm at San Antonio, Tex. The object of the work at this farm is to test new crops likely to prove of value to the region represented, and to find the best methods of tillage by which the relatively large but irregular rainfall of the region may be utilized in the profitable production of the staple crops.

FOREST SERVICE.

NATIONAL FOREST RESERVES.

The fiscal year 1905–6 was and will remain notable in the history of the Forest Service for the progress made in actually applying a National reserve policy. In area the reserves were increased during the year from 85,693,422 to 106,999,138 acres. In revenue the reserves brought in $767,219.96, as against $60,142.62 for the previous year, and $58,436.19 for the year 1903–4. In timber sales there were disposed of for immediate or early removal nearly 300 million board feet of lumber at stumpage prices ranging up to $4 per thousand (besides other material to a large value), as against 96,060,258 board feet, with a maximum price of $2.50 per thousand in 1904–5, and 69,257,710 board feet in 1903–4. The number of free-use permits granted in the same years also showed progressive increase. In the year 1904–5 the reserves were under Forest Service control only after February 1.

One fiscal year of full control has established two important facts—that the reserves advance the present interests of the people of the West and that they will speedily pay the cost of administering them.

PUBLIC UTILITY OF THE RESERVES.

These National forests are being made useful now. The benefits which they are to secure are not deferred benefits. Thru Government control the interests of the future are safeguarded, but not by sacrificing those of the present. Far from handicapping the development of the States in which they lie, the reserves will powerfully promote development. They work counter to the prosecution of no industry, and retard the beneficial use of no resource.

The wealth of the West lies, and will long lie, in what the soil will produce and in what the earth hides. Labor and capital will here find employment mainly in turning to use the farm land, grazing land, timber land, and mineral lands of the region, and in the commerce to which these great productive industries will give rise. That the reserves beneficially affect all of these industries is becoming clearer to the people of the West every day, and in consequence the policy of public administration of our unappropriated timber lands becomes more and more firmly established in the approval of a united public sentiment. Local sentiment has sometimes been unfavorable to the creation of reserves before their effect upon the public welfare was understood; but opposition has always dissolved under the test of actual experience.

The reserves do not withhold land from agricultural use, but greatly increase the amount of available farm land. Tho they were made from the most rugged and mountainous parts of the West and were intended to include only land unsuited for agriculture, by the act of June 11, 1906, the right is given settlers to homestead within the reserves wherever strips and patches of tillable land can be found. At the same time, thru their water-conserving power, these forests fix in regions of scanty rainfall the amount of land which can be brought under the plow, since at best much otherwise fertile land must go uncultivated for want of water. Without forest preservation much of the land now under irrigation would have to be abandoned again to the desert. Thus the promotion of agriculture is one of the main ends of the forest-reserve policy.

Mining in the West is mainly in regions surrounded by reserves or included within them: but the reserves do not impede the development of mineral resources. On the contrary, by guaranteeing future supplies of timber they are indispensable to the future development of these resources, as the great mining interests well know. They do not interfere with the prospector, who has the same right to prospect and locate in forest reserves that he has on any other part of the public domain.

Administrative control of the forest reserves is beneficial to the grazing industry. The sentiment of stockmen thruout the West is unitedly in favor of such control, because of the gain to them now that the reserve ranges are safe from overcrowding and deterioration. Thus the rights of the individual user are respected and the permanence of this great resource is assured. I wish to commend particularly in this connection the heartiness and good spirit with which the associations of western stockmen have cooperated in our efforts to enforce fair and just measures for the regulation of grazing in the interest of

all users of the forests, and in the interest of the public, to whom these forests belong. The charge of a grazing fee, made for the first time during the past year, tho reasonable in view of the advantages of grazing regulation to the stockmen and the cost of reserve administration to the Government, and justly due in the interest of the public, might have been expected to cause dissatisfaction and friction. On the contrary, as soon as the reasons for the charge and the method in which it would be applied had been explained, it was generally approved and paid willingly and promptly. It was followed by no falling off in the number of stock grazed in the reserves. In some cases the associations of stockmen have voluntarily aided the Service in settling local difficulties. Their whole conduct has shown remarkable moderation, far-sightedness, and readiness to recognize and accept what is in the permanent interest of their industry, even tho it involves the sacrifice of immediate personal advantage.

Finally, Forest Service administration of the reserves is beneficial alike to the lumber industry and to the timber-consuming public. There is now standing on the reserves not less than 300 billion board feet of merchantable timber. This is not locked up from present use as a hoarded supply against future needs; it is ready for the immediate demands of a developing country. It will not be rushed upon the wholesale market in competition with the cheap stumpage prices of private owners anxious for ready money, and it will not be disposed of under a short-sighted policy of utilization which would leave a gap between the end of the present supply and the oncoming of the second crop; but it is and will continue to be available, first for the small user—home-builder, rancher, or miner—and then for the needs of lumber concerns, large miners, and railroads, for which a timber supply is indispensable, and which in turn are indispensable to the prosperity of the West.

The supply of timber furnished by the matured crop now on the ground is so vast in proportion to the present demand that there might seem to be no need for caution in its use. Were no more cut than last year it would suffice for four hundred years. In the mature forest production is at a standstill, so that from the point of view of the largest possible production of timber lumbering under such methods as will insure a second crop is highly desirable. The demand upon the reserves, however, is as yet insignificant in proportion to even the present need, most of which is met by the supply from private holdings. The reserves form the heart of the western timber lands. They are generally less accessible than the private holdings which surround them, and would naturally form the last resource of the lumberman. They must be so maintained as first of all to be ready to meet the future demands of the regions in which they lie. With a growing population and expanding industries these demands will far exceed those of the present. The crucial problem of management will be to insure a timber and water supply for the great West, and to conserve the summer stock ranges. To meet it successfully will require careful foresight and the best technical information. Timber sales are now made with strict attention to the welfare of the forest, and at stumpage prices often decidedly in advance of the market.

THE RESERVES SELF-SUSTAINING.

The income from the reserves is as yet but a small fraction of what may be expected as they approach full utilization. Yet their adminis-

tration is already on a sound business basis. Not only are they meeting from their receipts a very large part of the cost of their maintenance; they are even now beginning to show a decided decrease in net expense to the Government. My estimate of the appropriation necessary to meet the general expenses of the Forest Service is less by $100,000 than the appropriation of last year, notwithstanding that the total area of the reserves has been substantially enlarged by Executive action; that increasing use necessitates greater expense of administration, and that in general the work of the Service is growing very rapidly. Tho the administration of the reserves forms but a part of the field of work, it may confidently be expected that within five years from the transfer of the reserves to this Department the Forest Service will cost the taxpayer nothing whatever.

In reaching this result no unjust burden will have been laid on any interest. As public property the National forests should yield to the public a reasonable return for whatever of value private individuals secure from them for their own profit. In accordance with this principle, applicants for special privileges—as rights of way, reservoir sites, power-house sites, and similar concessions—have been called upon to pay for such privileges on the basis of their commercial value. For example, in the case of water powers duly located under the State laws, but which can not be developed without the occupancy of reserve land, besides a charge for the land occupied, based on its value as forest land, a small charge per unit of power developed is made, not for the use of the water itself, which is granted directly by the State but for the conservation of the supply which the preservation of the forests furnishes, and which, were it not for the existence of the reserve, the water-right owner could secure only by himself acquiring great bodies of forest land. Such a charge is essentially similar to the charge for stock grazed upon the reserves. It is a return for actual value received, and throws upon those who profit by public control of the reserves a share of the cost of maintaining that control.

By the wise and just provision of Congress in enacting at its last session that 10 per cent of the gross receipts from the National reserves shall be made over to the several States in which they are situated, for the benefit of the counties which would otherwise receive no revenue from a part of their area, a real grievance was redrest. Even with the present use of the reserves the benefits thus reaped from them by the communities in their neighborhood are of substantial importance. As time goes on the importance of this provision will increase, and eventually the counties will find themselves far better off than they would have been without the reserves, for private ownership followed by exploitation would have destroyed the sources of revenue by leaving little or nothing of permanent taxable value, whereas now every resource is conserved and will be made to pay its just share of income. Since the fundamental purpose for which reserves exist is to secure the best permanent use of all resources, their effect is to add to property value, and by turning over 10 per cent of their gross receipts to local use they will contribute far more to the local public needs than the taxes they would pay if they were private property.

Protection of the reserves from fire has been the most important task laid upon the Forest Service. It is cause for congratulation that the loss by fire during the year was so slight. Indeed, the saving which resulted from the organized care of the reserve force was undoubtedly worth more than the whole cost of administering the

reserves. Only about eight fires of any consequence occurred on the reserves during the calendar year 1905, a season of extreme dryness and one in which under ordinary circumstances the damage from fires should have been unusually large. This small number was due in large part to the system of patrol, which leads to the discovery of fires before much damage has been done. So far during the calendar year 1906 the damage from fire has been extremely small, even in comparison with that in 1905. Increased efficiency of the patrol system, combined with favorable climatic conditions, has led to this favorable result.

WORK OF THE YEAR.

FOREST MANAGEMENT.

The progress made by the Forest Service in the brief period of seventeen months, during which it has had charge of the reserves, in introducing management upon a vast field of operations in virgin forests of varied types, compares favorably with anything that the history of forestry can show in any country. From Minnesota to southern California and from Washington to New Mexico, reserve timber is now being cut under regulations looking to a second crop. With larger experience the methods now applied will doubtless be found faulty in some respects, and with opportunity for more intensive use which the rising value of timber will afford, much more satisfactory results will be possible; but the important fact is that, confronted with a problem of unexampled magnitude in its kind, the Forest Service proved able to substitute conservative for destructive use, while greatly increasing the use itself.

Live timber is cut on the reserves under stipulations based on actual study of the forest conditions to protect the forest and the water supply from injury. Piling of the waste left by logging is always required, a diameter limit is set to prevent too heavy cutting, seed trees are left where necessary to provide for reproduction, full utilization of all salable material is compelled, and young growth is protected from injury. All this the purchaser is under contract to perform, under the supervision of the forest officers, who are held to efficiency by systematic inspection. Yet in spite of these requirements, which slightly reduce the profits of lumbering to the purchaser, record stumpage prices have often been obtained, and the average price realized has been far above that usually paid in the same regions. Living trees to be cut are marked beforehand by the forest officers, who also scale the lumber before it is removed.

Tho some large sales of timber have been made in regions where great quantities of mature forest were available and exposed to deterioration, the constant policy has been to encourage the small user. Besides the free-use permits, in more than 99 cases out of every 100 the sales were of less than 5 million board feet.

Receipts for the sale of timber on the reserves were nearly $250,000, while the contract sales of the year reach a total of over $500,000. Five years is the longest period allowed under these contracts in which to cut the timber sold. Timber which can be harvested with profit only by large operations and with a heavy outlay for the construction of a milling plant or means of transportation, or both, must necessarily be sold under a contract extending over several years; but no sales are made permitting the speculative holding of timber against a rise in market price.

The largest totals of sales by States were in South Dakota (73 million board feet), Wyoming (71 million feet), and Montana (over 53 million feet). In the latter two States heavy lodgepole pine forests are ready for the ax, but difficult to lumber from their inaccessibility. At the same time a sudden demand for lodgepole pine railroad ties has opened a market for this timber and made it possible to sell by large contracts under conditions which will permit a second cutting after thirty or forty years. In South Dakota a special reason exists for pressing the sale of timber with the utmost energy. By the ravages of a bark beetle great quantities of timber are being destroyed, and the annihilation of the entire forest of the region is threatened. Only by extensive cutting of infested trees can the spread of the beetles be checked and the damaged timber be utilized.

In Colorado and Arizona sales of timber totaled over 27 million board feet for each State, and in Utah and California over 10 million. In Colorado and Utah these sales were mainly of fire-killed timber, largely used in mining. In Arizona large quantities of mature accessible timber permitted extensive cutting without injury to the forest. In other States cutting was comparatively insignificant in amount, save in Idaho, where nearly 9 million feet were cut.

Little difficulty was experienced in preventing timber trespass upon the reserves. Where such trespass occurred the full value of the timber taken was recovered. Practically no loss was sustained from theft.

COOPERATIVE MANAGEMENT.

The Forest Service continues to receive applications from private owners for assistance in introducing forest management upon their holdings. So far as possible the Forest Service will give aid in this work as in the past, since it is plainly in the public interest to promote the practise of forestry among private owners on business principles. It is significant that while at the first it was necessary to prepare a working plan for every timber tract before recommendations for conservative management could be made, during the past year, out of 54 timber tracts examined, it was possible on 43 to outline at once a system of management and the regulations to put it into effect. Working plans were made during the year for 6 large tracts in New York, Kentucky, Michigan, and South Carolina, and for 100 woodlots in 16 States.

In the woodlot work, which assists small owners, particularly farmers, to make the best use of their woodland, special attention was given to the Middle West. Very different problems are here presented from those of the Eastern States, hitherto the main field of woodlot study. As the need of timber becomes more pressing, the yield from these small forest areas, which nevertheless in the aggregate form a large part of our total woodland area, will become increasingly important. On the whole, the farmer knows how to utilize his woodland far less intelligently than any other part of his farm. If he can be brought to an early realization of the future value of good timber and knowledge of how to grow it, great benefit will result, both to the farmer and to the community, which later will stand in need of every available supply.

Cooperative forest studies were carried on during the year with the States of California, New Hampshire, and North Carolina; with the

Office of Indian Affairs of the Department of the Interior, on the Wisconsin Indian Reservation; with the War Department, on the military reservation in New Mexico; and with the Hydrographic Division on the United States Geological Survey, upon the Potomac River watershed. Tie production in Wisconsin and Minnesota, in cooperation with the Northern Pacific Railroad, and the effect of sulfur fumes from smelters on neighboring forests in Tennessee, in cooperation with private forest owners and with the Bureaus of Chemistry and Entomology, were also studied.

FOREST EXTENSION.

The field of forest planting in the United States broadens with every year. In the East the economic conditions are bringing rapidly nearer intensive forest management, which will involve extensive planting, both to stock the land fully and to shorten the interval between crops. In the Middle West the rising value of lumber is tending to make the growing of trees profitable on land now in pasture or under the plow. Knowledge gained by past investigations of how to make trees grow under adverse conditions opens enlarged possibilities to private owners in the more arid parts of the far West. By far the most important part of the field, however, is that of reserve planting. Here in the future a gigantic task will be presented, upon which the Forest Service has already begun a preliminary attack. Planting will furnish a future timber supply, improve drainage basins, and replace inferior species with more valuable trees. Of the 107,000,000 acres of reserves enormous areas are partly or wholly unforested.

In the Middle West alone are 5 reserves, aggregating over 750,000 acres, which are practically treeless and on which planting is now under way. Doubtless future additions to the reserves will still further increase the task. While some of this land may never support trees, the public welfare will eventually demand that the larger part of it be forested. Unaided natural reproduction can never accomplish the task in time. As the need for wood and water increases, planting on a scale as yet entirely unthought of in this or any other country will be carried on.

For private planting the two most serious obstacles to widespread activity are the high cost and the poor quality of both the nursery stock and the tree seeds now commercially obtainable. In some cases eastern tree planters have been compelled to import from Europe nursery stock of American trees, and adulterated seeds are common on the market. It is not possible for the Forest Service to supply nursery stock for private use, but it is doing what it can to aid the planter by tests of the purity and germinative powers of seeds furnished by different dealers, and by information as to prices at which seeds and stock may be obtained in different regions.

For planting on the reserves the Forest Service must raise its own material. Six planting stations are now established, with an annual capacity of 6,000,000 seedlings. Yet to plant 1 square mile requires more than 700,000 seedlings. Tho four years have past since the first nursery station was established, the work as yet done has been hardly more than experimental, and in the newer nurseries few of the seedlings are old enough to plant out. To meet the needs of the reserves, preparations for planting must be made on a vastly greater scale.

As a first step, nursery sites will be established at rangers' headquarters on all the reserves. As rapidly as possible the reserve force will be trained to carry on this work, and nursery stations will be multiplied.

The real progress made toward reserve planting appears not in the number of trees set out or the present capacity of the stations, but in the fact that practical methods of doing the work at reasonable cost have been found. In spite of the high cost of labor in this country, an acre of land can now under ordinary conditions be planted to forest by the Service almost as cheaply as the same work is done in Germany. The whole problem of successful forest planting under the conditions of aridity, elevation, lack of transportation facilities, and scarcity of labor, combined with the lack of any experience which could guide to right action, was one of extreme difficulty. Tho much yet remains to be done before a perfected system of planting will have been secured, the work now done amounts to a demonstration that success is within reach. This in itself is no small achievement.

COOPERATIVE PLANTING.

The Forest Service cooperates with private owners to secure forest extension by preparing planting plans for them. Two years ago the average size of the planting plans made was 68 acres. Last year it was 310 acres. This is significant of changing conditions. Increasingly as the necessity of provision for the future needs becomes plain, large owners are seeking the cooperation of the Service. A number of railroads have begun to plan for tie production from planted timber; coal companies are preparing to utilize waste land, and cities are seeking to improve their watersheds and at the same time derive a revenue from the land held for watershed protection.

Examinations were made of over 300,000 acres on which the owners wish to consider planting, and detailed planting plans were made for over 10,000 acres in 19 States.

Cooperation with other Departments, by the preparation of planting plans, included the War Department, the Bureau of Fisheries of the Department of Commerce and Labor, and the Reclamation Service of the Department of the Interior.

DENDROLOGY.

The investigation of turpentining methods was pushed along lines which promise important economic results by diminishing the wound inflicted on the tree and greatly prolonging the period during which a tract may be worked. A chemical study of the turpentine from different species of pines (conducted in cooperation with the University of North Carolina) is under way to learn which species furnish the most valuable yield.

Studies of forest distribution and resources were continued. The experimental basket-willow holts demonstrated the success of the cultural methods advocated by the Service by producing a crop of rods of the finest quality. Analyses of willow barks established their value for use in tanning. By the identification of many samples of woods valuable information was furnished wood users.

FOREST PRODUCTS.

An important means of reducing the drain upon our forests is the treatment of wood by seasoning, by the use of chemicals, or by both

combined, to make it last longer. Careful experiments are under way to determine the most effective and economical methods of treating railroad ties, telephone and telegraph poles and cross arms, and fence posts. Material cut at different times of the year, seasoned at different times of the year, and by different methods, and treated by different processes is being tested in service to find out how it can be made most durable.

Wood distillation to utilize the waste product of lumbering, and the suitability of untried woods for making paper pulp, were made the subjects of special studies.

Over 12,000 tests of the strength of timber were made. The woods tested include loblolly pine, red fir, western hemlock, Norway pine, tamarack, white and red oak, and eucalyptus. By these tests, which show the suitability of the various kinds of wood for different uses, both timberland owners and those who employ wood in building and manufacturing have received great benefit. New woods have been brought into use and economy in the use of material has been promoted. The present facilities for this work are inadequate, and it is important that a special laboratory be provided at Washington.

By statistical study of the production and consumption of lumber in various forms and compilation of the various grading rules now in use, information greatly desired by the lumber trade but never before obtainable was gathered, better conditions were promoted, and light was thrown on the highly important question of the probable duration of the country's lumber supply. Special studies of the manufacture of cooperage stock, of vehicles and implements, and of boxes, and of certain kiln-drying methods, gave results of decided value both to the manufacturers and to timber-land owners. Wood as a paving material was also studied, and experiments were started to discover the best kinds of wood to use and how they should be treated and laid.

BUREAU OF CHEMISTRY.

The activities of the Bureau of Chemistry during the year included a great variety of investigations.

EXAMINATION OF BUTTER, MILK, AND CREAM.

More than 800 samples of butter were investigated, to see if they complied with the requirements of the law relating to renovated butter. A study of the effects of cold storage upon the chemical composition of milk and cream was inaugurated, to determine the length of time during which such products can be safely kept in cold storage.

CEREAL INVESTIGATIONS.

The effect of environment upon the content of sugar in Indian sweet corn was studied. The almost universal use of sweet corn for food thruout the country renders such an investigation of peculiar interest to consumers as well as to producers. A single variety of seed was planted in different localities from South Carolina to Maine, and the quantity of sugar in the product was carefully determined. At the same time meteorological data were secured which are utilized in determining the effect of environment in all of its factors upon the composition of the product. It was found that within twenty-four hours after harvest, if exposed to ordinary temperatures, a very considerable percentage of the sugar has disappeared from the grains of

the corn. This fact has led to the observation that it is necessary to market the product as soon as possible after harvest, and meanwhile to keep it at as low a temperature as can be secured.

Studies looking to the improvement of the different varieties of Indian corn, by selection based upon analytical data, were undertaken. These studies are a continuation of those conducted the preceding year upon the effect of environment on the chemical composition of the sugar beet. In all, over 3,000 analyses were made of cereals in the prosecution of the above investigations. These investigations also include the effect of environment upon the chemical composition of barley as related to the brewing industries.

STUDY OF DENATURED ALCOHOL.

An important investigation was also begun upon the economic production of alcohol from various raw materials in relation to the production of denatured alcohol for industrial purposes. The object of this investigation was to discover the value of various waste materials of factories—wood, molasses, sweet potatoes, cornstalks, etc.—in the production of alcohol for denaturing. This work is likely to prove of great value to our farmers in developing new sources of income from the production of denatured alcohol for industrial purposes.

TESTING OF SUPPLIES FURNISHED UNDER CONTRACT.

In the Contracts Laboratory, the object of which is the examination of materials furnished to the different Departments of the Government under contract, 69 samples were examined for the War Department, 19 for the Navy Department, 65 for the Department of the Interior, 36 for the Treasury, 73 for the Post-Office, 1 for the Department of Commerce and Labor, 73 for the Government Printing Office, and 59 for the Department of Agriculture. These examinations were of the most rigid character, and the result of the work has been to secure a much higher quality of material than was formerly supplied under the contract system.

EXAMINATION OF DRUGS.

The examination of drugs has been particularly fruitful during the year. Five hundred and fifty-three samples were examined for purity and quality. A large part of the work of the Drug Laboratory has been in connection with the Post-Office Department for the purpose of suppressing traffic in fraudulent preparations transmitted thru the mails. As the result of these investigations a large number of fraud orders has been issued forbidding the use of the mails for such purposes. Other important investigations were undertaken in the testing of chemical reagents, of oils and essences, and of plant drugs.

ANALYSIS OF WATERS, INSECTICIDES, AND CATTLE FOODS.

The examination of waters used as beverages has been continued, and also the analysis of waters used for irrigation. Thirty-nine samples of insecticides were investigated during the year. Studies were made also of the lime-sulfur-salt wash and allied mixtures. One hundred and fifty-four samples of cattle food were analyzed to determine the quality of the cattle foods sold upon the markets. Studies

were also made of the injurious effects of fumes from smelters upon vegetation, and testimony was given in the courts relating thereto. It is evident that the sulfurous acid fumes produced in most smelters are of a character to injure vegetation and also animal health in a region very widely extended about the factory. It appears probable that in the near future smelters will be required to convert the sulfurous acid into sulfuric acid or some other substance which will not cause the injuries above mentioned.

STUDY OF TANNING MATERIALS, PAPER, AND TURPENTINE.

The study of tanning materials was continued, especially of the Sicilian sumacs. The effects of different tanning materials upon the character, quality, and durability of leather were investigated. Investigations of great importance, not only to the various Departments of the Government but to the people in general, are those relating to the character of paper used for public records. Investigations have been continued respecting the composition of turpentine distilled from wood and its relations to the ordinary turpentine.

FOOD INSPECTION.

The food and drugs act, June 30, 1906, imposes upon the Department additional duties of a most important character. The two chief purposes kept in view by this act thruout all its sections are, first, to prevent the introduction of any injurious or debasing substance into foods or drugs, and, second, to secure the correct labeling of all food and drug products. This act applies to all interstate and foreign commerce in all foods and drugs, and also to all imported meat food products. The proper enforcement of this act must prove of immense benefit to all the people of this country in securing freedom from adulteration and fraud. Regulations providing for the administration of the law have been carefully prepared, and 30,000 copies have been distributed throughout the country.

The inspection of imported foods at the ports of entry has been extended, especially at New York, Boston, and Philadelphia. The earthquake and fire at San Francisco in April unfortunately destroyed our laboratory at that port. It is hoped that this enforced suspension, however, will not be of long duration.

Five thousand seven hundred and forty-nine samples of imported food products were examined during the fiscal year. Of the 1,246 samples which were found not to comply with the law, 531 were released without prejudice because it was evident that no intent to defraud or deceive the people of the country existed; 577 were admitted after being relabeled so as to comply with the provisions of the law; 138 invoices were required to be reshipped beyond the jurisdiction of the United States. In addition to the above number of samples, 8,735 inspections were made upon the floors of the appraisers' stores.

The effect of the food-inspection law on foreign commerce has been most salutary. In many cases kinds of food products which were formerly very generally misbranded are now found to be almost universally free of suspicion. There has been a very decided improvement in the quality of imported food products, due to inspection.

FOOD STUDIES.

The Division of Foods has also conducted special investigations into the extent of domestic adulteration of food products and an investigation of tropical and subtropical fruits, as well as of fruits of domestic production.

A very extensive investigation made to determine the character of distilled liquors, both those imported into the United States and those of domestic manufacture, has been practically completed.

The study of the effects of colors, preservatives, and other substances added to foods has been continued during the year, and most valuable data relating thereto are now being prepared for publication. This investigation is particularly valuable because the experiments are made upon human beings.

MICROSCOPIC WORK.

The microscope has become one of the most valuable adjuncts in the examination of food products and materials used for technical purposes. Micro-chemical investigations have been largely made in the work of the Bureau of Chemistry and have extended not only to foods but also to leathers, papers, tanning materials, and bacteriological examinations. The total number of samples examined during the year was 1,067. The bacterio-chemical work has been of extreme importance. This is especially true in connection with the work authorized by Congress on the effects of cold storage upon wholesomeness of food products. Particularly in investigating the relative merits of drawn and undrawn fowls when placed in cold storage, the bacterio-chemical examination is of vital importance. Studies have therefore been made to determine whether the bacteria of the intestinal tract migrate to the flesh of the fowl during the period of cold storage, and, if so, what chemical changes are produced thereby. The bacterio-chemical investigations have extended to a large number of other subjects, particularly to the chemical changes which take place in milk, cream, and evaporated and condensed milks, and to the general changes of a bacterial character which foods undergo on keeping.

BUREAU OF SOILS.

Underlying all attempts to improve the general agricultural welfare of the country lies the necessity for a correct knowledge of the character and variety of its soils. Such knowledge is fundamental, and without it no great progress can be made in securing further diversification of crops, the introduction of new crops, or the more economical production of the great staples now known.

THE SOIL SURVEY.

Since 1899 the Bureau of Soils has been conducting an investigation of the soils of the United States which will ultimately result in a thoro familiarity with the vast, varied, and but partially appreciated soil resources of the country. The purpose of this work is to ascertain the variety and extent of the chief characteristic soils of the country, to determine the crop or crops which can be raised to the best advantage upon each of these soils, and to discover what peculiarities of soil management are best suited to secure the maximum results on each soil in different and widely separated localities.

EXTENT OF THE SURVEYS.

During the fiscal year 1906 soil surveys covering 19,341 square miles, or 12,370,240 acres, were made in 29 States and 2 Territories. In all, to June 30, 1906, 251 different surveys have been made in 43 States and 4 Territories, covering a total area of 118,687 square miles, or 75,959,680 acres. These surveys have covered not only a wide range of soil and climatic conditions, but also the typical soils upon which the chief staple crops as well as many new and special crops are being produced.

THE PROBLEMS ENCOUNTERED.

The work of the soil survey in 1906 and in preceding years, while dealing chiefly with the characteristic soils upon which the staple crops—corn, wheat, cotton, grass, etc.—are produced in different sections and under different conditions of soil and climate, has also encountered many specific problems of wide interest and application. The opening of large areas for agricultural occupation has necessitated in several States a study of the existing soil types in order that the appropriate crops for production upon each might be determined. The widespread interest in the agricultural capabilities of undrained lands in many sections has led to demands for surveys which shall determine the character of crops to which such soils may be farmed after reclamation. The breaking up of large dry-farmed ranches for more intensive forms of agriculture under irrigation has also necessitated surveys which could be used as a basal guide in crop selection. The extension of crops like tobacco and alfalfa into entirely new areas whose soil adaptations were formerly unknown has been made possible by the soil surveys. The introduction of new crops has been accomplished along the lines suggested by the surveys. One of the chief purposes and uses of the surveys has been to aid individual farmers in the selection of land suited to general or special crops in regions unknown or but partly known.

THE SOIL RESOURCES OF THE COUNTRY.

In the work of the soil survey, since its inception in 1899, 461 distinct types of soils have been encountered. Some of these types are of great extent, covering areas measured by thousands of square miles. Still others are of local extent and distribution. Some are distributed over a considerable range of climatic environment. Others are so restricted that they may be said to lie in a single climatic belt. The great striking fact, however, is that with such a great variety of individual soils only about a dozen important crops are now produced in the entire country. Again, the same crop is produced with the greatest diversity of success or failure upon a great variety of soils, to some of which the crop is well suited while upon others it is annually produced at a loss. Before the farmers of all sections of the United States can reduce agriculture to a basis of permanent business success the knowledge of these facts must be thoroly disseminated and fully understood.

It has been found that in addition to the broad subdivision of the country into a humid region, an arid region, and a rather indefinite semiarid region, there are at least thirteen grand divisions among the soils which may be termed soil provinces. The soils of the Atlantic and Gulf Coastal Plains differ materially from those of the Piedmont Plateau. The soils of the glaciated region of the Northern States are

materially different from those of the limestone valleys, and from the alluvial bottom lands or the residual prairies of the Western States. Still greater differences exist between the soils of the Pacific coast valleys or the Great Interior Basin and those of the Eastern State provinces. All of these differences have their deep significance in the selection of crops and in the management of the soils. Even within single provinces there are groups of soils which differ profoundly from all others, and these differences must be recognized and their crop signification understood. Each series also ranges from the coarsest sandy and gravelly types or individuals to the finest-grained clays. No two of the numerous individual soils possess exactly the same characteristics, and no two are, therefore, adapted in the same degree to exactly the same crops nor to the same treatment and handling.

When all of these differences have been ascertained, and when the significance of these differences comes to be understood, the country will be able by the introduction of new crops and by greater specialization in crop production to increase greatly the agricultural efficiency of every tilled acre.

DEMANDS FOR THE WORK.

Each year brings an increasing number of requests for survey work in particular localities to serve a great diversity of interests. The development of new lands in the United States has not ceased and the need for specific and unprejudiced information concerning soils in newly developed regions has become widely recognized. The extension of tobacco culture thru certain portions of the Gulf States has led to numerous requests for surveys to locate areas of soil where the Cuban type of filler tobacco may be grown successfully. Only a few soils are suited to the production of this leaf, and unless such soils are found in an area the attempt to introduce the crop must result in failure. The growth of the fruit interests in all sections of the country has led to widespread demands for surveys to determine what soils are peculiarly adapted to the growing of apples, pears, peaches, grapes, or citrus fruits, the location of these soils, and their extent. The depression of farm values in some sections has called attention to the possibility of rehabilitating these farms and soils thru the introduction of new crops and of new methods, and surveys are requested to furnish guidance along these lines. New areas for the production of market-garden and truck crops are being developed along the Atlantic and Gulf coast lines, and surveys have been requested for many of these areas. The northward spread of the culture of rice upon prairie lands has given rise to requests for surveys to indicate soils and regions where this crop might be introduced.

As a result the Bureau of Soils has always on file requests for several times as many surveys as can be made during any one year, and the completion of each year's work is accompanied by an increased rather than a diminished volume of requests. While such a condition is gratifying from the standpoint of public appreciation of the value of the work, it is embarrassing and unsatisfactory because of the necessity for selecting among so many requests of almost equal urgency those areas which may be undertaken each year. The public demand for the making of these surveys and the constant application for survey reports, not only for areas which have been surveyed, but also for those which have not yet been undertaken, both evince the necessity for a considerable increase in the volume of soil-survey work in the immediate future.

RECLAMATION OF ALKALI LANDS.

The progress of the work on the several alkali reclamation tracts during the fiscal year just closed has been gratifying, both as regards the immediate success of the experiments and as regards the stimulating effect that these results have had upon private initiative in the work of reclaiming similarly affected neighboring lands.

PROGRESS ON THE UTAH TRACT.

On the Swan tract, near Salt Lake City, Utah, the work consisted largely of experiments with various crops, as the removal of alkali had practically been accomplished by repeated flooding in 1903 and 1904. The thrifty growth of alfalfa and of other crops, not perhaps as sensitive to alkali, clearly demonstrates the great changes that have taken place in the soil since it has been treated. Formerly this field presented a desolate appearance, with large areas heavily incrusted with alkali. The success of this experiment can not but be far-reaching in its influence upon the alkali question in the Salt Lake Valley.

COMPLETION OF WORK AT FRESNO.

Our earlier work on the Toft-Hansen tract, near Fresno, Cal., had freed the upper layers of soil from alkali, and very satisfactory crops had been grown; however, while the alkali question had been solved, a constant source of danger was the high ground water, which rises very rapidly in this district after water is turned into the canals each spring. The original drainage system was not very deep, and the question of keeping the drains free from sand and silt proved serious. In order further to experiment with the lowering of the ground water, it was thought advisable to install a new drainage system. This was completed in November, 1905. The entire drainage system was lowered from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet, and the ground water is now kept at a safe depth, not only under the land drained, but under adjoining farms to the extent of 200 acres.

The success of this work has proved of great value to the farmers of the alkali and seepage-infested district about Fresno, and many have signified their intention of undertaking work similar to that carried on by the Bureau of Soils. At the close of the irrigation season of 1906, the Bureau's work in the Fresno district will close, as the owners of the land are well pleased with the reclaimed condition of the soil and the success of the newly installed drainage system.

CONTINUATION OF THE WORK AT YAKIMA, WASH.

In Washington, in the Yakima Valley, the results have not been quite as satisfactory as was hoped when the work was commenced. While parts of the Gervais tract, near North Yakima, have been thoroly reclaimed and produced in 1905 a heavy crop of hay, valued at $160, other parts of the tract have not yielded to treatment so readily. That some parts of the tract still contain appreciable quantities of black alkali is evident from the crop returns, from repeated chemical tests, and from the characteristic dark stains in the soil. It is somewhat difficult to explain the retention of alkali by the soils of the Yakima Valley. It is well known that hardpan retards the movement of alkali, and it seems probable also that the volcanic ash soils of this valley may have a high absorptive capacity, enabling them still to retain injurious quantities of black alkali in spite of repeated flooding.

Good lands in this region produce such profitable crops that the exact treatment for the alkali lands should be ascertained if possible, even tho the total cost of reclamation be great as compared with other districts.

RAPID COMPLETION OF THE RECLAMATION WORK IN ARIZONA.

The record of the Cummings tract, near Tempe, in the Salt River Valley, Arizona, is excellent. The drainage system was installed early in 1904, but no water was available for leaching out the alkali until many months later. When the water supply became more abundant the removal of the alkali was comparatively simple. At the present time 14½ acres support a fine stand of alfalfa, planted in November, 1905, while the remainder has produced a heavy crop of barley. The owner of the land is fully satisfied with the showing of the crops and only awaits the seeding of the small tract to alfalfa before accepting the land according to the contract originally agreed upon. As the water supply of the valley is still further increased by the extensive operations of the United States Reclamation Service in constructing storage reservoirs, the subject of eliminating alkali and controlling the ground water will become more important, and the Bureau is very fortunate in having undertaken and completed this work at such an opportune time.

RESULTS IN MONTANA.

The showing of the O'Donnell tract in the Yellowstone Valley, Montana, is fully as good, if not better, than the one just mentioned. The drainage system was installed during 1904, but too late to allow any flooding. During 1905 the land was continuously flooded for several months. From the outset the drainage system worked perfectly and large quantities of alkali were removed by the drainage water. Tests made in June, 1906, showed that the alkali content to a depth of 4 feet had decreased to approximately 0.2 per cent over the entire tract. In 1904 the soil contained more than 1 per cent to a depth of 4 feet, largely concentrated in the first and second feet. The comparison shows the extent to which the alkali had been removed by a single year's flooding. Early this year the soil was put in order and seeded to oats. This crop produced a yield that compared favorably with the most productive lands in the valley.

Since it has been shown that alkali can be removed from the soils in the Billings district the outlook is most promising. One of the worst alkali and seepage areas has been included in a drainage district, and a deep outlet ditch now constructed will serve to carry the surplus water from smaller, more detailed drainage systems in individual fields. Smaller local drainage systems are also being formed by private enterprise.

NEED FOR CONTINUING THE DEMONSTRATIONS.

In carrying on the work in reclaiming alkali soils we have had many different conditions to meet and local difficulties to overcome. At each tract the character of the soil differed from that of the other tracts, and at no two places are the alkali conditions nor the details of attacking the problem the same. This makes plain the wisdom of extending the work to other affected districts in order that full and exact plans may be placed in the hands of the farmers suffering this common evil of the arid West.

Already urgent requests for the extension of this work are on file in the Department, and in view of its great economic importance it is the intention to follow the completion of the present demonstrations with the reclamation of small tracts in some other of the worst affected sections. There is no one soil problem more important to a large number of our western farmers than this, and none, happily, that is capable of such quick solution or that involves so great and so certain immediate increase in their wealth.

TOBACCO INVESTIGATIONS.

During the fiscal year just closed the Bureau of Soils has continued its investigations for the improvement of tobacco in Texas, Alabama, Ohio, Virginia, and Connecticut.

EXPERIMENTS IN TEXAS.

The tobacco grown in Texas during the preceding year was distributed to the trade for the purpose of ascertaining its commercial value. In all 300 samples were sent out, and from the numerous replies received it can be positively stated that the tobacco produced in Texas meets the requirements of the trade as a high-class domestic filler. About 200 acres are now being grown on the Orangeburg soils in Nacogdoches, Anderson, Houston, and Montgomery counties in east Texas, while in central Texas, in Lavaca and Lee counties, experiments were conducted on similar soils. The industry is now assuming a commercial status, as a ready market has been created for the leaf. Great interest has been shown by the trade, by railroads, and by local interests in east Texas as a tobacco-producing region, and, with the promising beginning made in the counties mentioned, there is every reason to believe that this section of the State will soon be recognized as an important factor in our tobacco industry.

PROSPECTS IN ALABAMA.

The investigations for the production of filler leaf in Alabama have this past year been extended into Dallas County, in the southern part of which the Orangeburg soils appear. In Perry County the acreage increased over 100 per cent. A ready market has been found for the product, and this has proved a stimulus to the growers. The tobacco produced is similar in quality to the Texas and Florida leaf, and the cost of production is a little less.

FERMENTATION AND SELECTION IN OHIO.

In Ohio the work of introducing the bulk method of fermentation has been continued, and over 25,000,000 pounds of tobacco have been fermented according to the method prescribed by the Bureau of Soils. It has taken a period of five years to accomplish these results, and the system is now so well established in Ohio that the packers should be able to proceed without further supervision by our experts. Besides the fermentation work, the work of introducing Cuban seed filler in Ohio has been continued, 25 acres having been planted by the farmers under the direction of the Bureau. This was contracted for with local packers at prices ranging from 18 to 20 cents a pound.

In Ohio, also, cooperative experiments have been conducted with the Bureau of Plant Industry in the selecting and breeding of improved types of tobacco, with a view to securing types of leaf giving a larger

yield and having a uniform quality. Selections were made of Zimmer Spanish, Little Dutch, Ohio Seedleaf, and Ohio Cuban. It is believed that by this method of selection of seed native varieties of Ohio tobacco may be greatly improved, since where so many varieties are grown, as in the Miami Valley of Ohio, there is great danger of their becoming mixt.

EXPORT TOBACCO IN VIRGINIA.

The experiments begun in Virginia in 1904 with heavy fire-cured tobacco have been continued during the past fiscal year. In the first year of this work it was demonstrated that by the use of carefully selected fertilizers the profits in growing this type of leaf could be increased considerably as compared with those obtained by the Virginia farmer. During the past year the same treatment of the same land was followed, and, between the two crops of tobacco, rye was sown as a cover crop and plowed under in the spring of the year. The results obtained show the accumulative effects of the fertilizer and cultural methods used. The land was divided into 3-acre plats. On one the fertilizer practise common to the locality was followed, on the second a slightly better brand was applied, and on the third a still more expensive application was made.

The cost of production of the three plats was respectively $44.50, $63.60, and $85.49, which shows a net profit of $15.63 on plat 1, $37.01 on plat 2, and $40.10 on plat 3. It is interesting to note that the same plats of ground receiving the same treatment in 1904 netted profits of $5, $21, and $24, respectively, showing gains in 1905 over 1904 of $10.62, $16.01, and $16.10, respectively. These results are highly significant as indicating what may be done in this important tobacco district by the use of such methods as are practised, for instance, by the Connecticut Broadleaf growers.

BEGINNING OF EXPERIMENTS WITH VIRGINIA BRIGHT TOBACCO.

Investigations for the improvement of the Bright tobacco of Virginia were also begun during the past fiscal year (ended June 30, 1906), in cooperation with the Virginia Experiment Station, the experimental field being situated near Chatham, in Pittsylvania County, the center of the Bright tobacco belt of Virginia, and within 20 miles of Danville, the largest market for this class of tobacco. The experiment is still in progress, and it will be impossible to report definite results until next year.

CONNECTICUT SHADE-GROWN TOBACCO.

In the Connecticut Valley the work of producing, under shade, a wrapper leaf having all the qualities demanded by the trade has been continued in connection with the breeding experiments of the Bureau of Plant Industry. Eleven selections were taken in a 4-acre tent, seven from Sumatra seed and four from Cuban seed of the third generation in Connecticut. The yield of Sumatra ranged from 1,445 to 1,612 pounds per acre, and of Cuban from 1,134 to 1,384 pounds per acre. Out of these eleven types there have been selected two types of Sumatra and one of Cuban seed that appear to meet the demands of the trade.

Besides the area in the experimental tent of the Department, there were grown by private planters during the year about 120 acres under cloth shade, both Cuban seed and Connecticut Broadleaf being planted.

This is a slight increase over the acreage planted the preceding year and indicates that the trade is becoming interested in the shade product. One firm growing Broadleaf sold the tobacco for $1,061 an acre, giving a profit of about $300 an acre. The Cuban tobacco was sold for $1,200 an acre. During the summer of 1906 the crop grown by the Department from selected seed of both the Cuban and Sumatra varieties was distributed to thirty-three of the largest leaf dealers and cigar manufacturers in the principal cities of the East. These were sent out with a request that they test the leaf and report to the Department their opinion of its quality and its adaptability for manufacturing purposes. Up to the time of closing this report answers have been received from twenty-five of those to whom samples were sent, and with one exception they report that the tobacco has all the qualities demanded by the trade in a domestic cigar wrapper, and if tobacco similar to the samples sent can be grown on a commercial scale they do not hesitate to say that a ready market can be found for it.

There can be no question that tobacco of this quality can be produced on a commercial scale by careful growers if the methods used and recommended by the Bureau of Soils are followed. Notwithstanding the uniformly favorable reports received from the trade on the merits of this tobacco, the Bureau, however, would caution the prospective grower against embarking in the industry on too large a scale at the outset.

PREVENTION OF POLE SWEAT.

Owing to the serious damage caused annually in Connecticut by pole sweat or house burn, the Bureau of Soils conducted some preliminary investigations in curing sheds containing both the cut and primed tobacco. A detailed record of the moisture and temperature conditions in each shed was kept, as also of the condition of the tobacco, with a view to determining the point of relative humidity and temperature of atmosphere at which tobacco would begin to pole sweat and the means to prevent the atmosphere of the shed becoming such as to favor its spread. This study will be closely followed, as it is believed that results can be obtained which will be of great value to the Connecticut growers.

Urgent demands have been made upon the Department to extend its operations into Florida, Maryland, Wisconsin, and Tennessee, but owing to the limited appropriation for this work it has so far been impossible to comply with these requests.

BUREAU OF ENTOMOLOGY

Practically all of the investigations under way in the Bureau of Entomology at the time of my last report have been continued with excellent results, and several new and important lines of work have been begun.

THE MEXICAN COTTON BOLL WEEVIL.

Encouraging progress has been made in the work against the Mexican cotton boll weevil, as shown by an extensive canvass of the cotton planters who have followed the recommendations of the Bureau.

Owing to climatic conditions in the summer and fall of 1904 and in the winter of 1904–5, some of the area that became infested late in the summer of 1904 was entirely devoid of weevils in the early part of 1905, but the fall movements of the weevil in 1905 more than covered

this area. This permitted studies for which there had been previously little opportunity, and many points which had a bearing upon the possibility of the continued advance of the pest were investigated.

EXPERIMENTAL FARMS.

The continuation of the experimental farms at fourteen places in Texas has been deemed desirable, as the value of experimental field work depends largely upon the number of seasons thru which it has been carried. Two additional experimental farms have been carried on in Louisiana. The whole acreage placed under contract in these experiments is 877.

The modifications in the cultural system of lessening damage, made necessary by the change in habits of the insect, were carefully studied in connection with the work carried on in the laboratory.

OTHER FIELD WORK.

In addition to experimental plats on a large scale numerous field experiments were conducted, including an extensive experiment in the hand picking of infested bolls and considerable other work directed to the solution of questions which can not be tested with the fullest practical effect in the laboratory.

The continued spread of the weevil has been carefully watched, and publications regarding the new territory infested have been issued in cooperation with the Weather Bureau. Careful study has been made of the conditions in western Texas in order to determine whether the weevil is likely to spread to that part of the State in spite of the general idea that such spread will not take place.

LABORATORY WORK.

In the well-fitted laboratory now located at Dallas, Tex., the effects of different temperatures and the condition of food supply upon the development of the weevil were tested, the breeding of parasites was continued, and a special study was made of a native ant which seems to be becoming more and more an important factor in the natural control of the weevil. Investigations of the distribution of this ant, its adaptability to different soil conditions, and the possibility of its artificial propagation have also been made.

TRUE PARASITES OF THE BOLL WEEVIL.

Since the weevil entered Texas native parasites have had little effect upon it until recently. During the year, however, it was found that in the Brownsville region—first entered by the weevil about 1903—native parasites have accommodated themselves to its habits, and now at least 50 per cent of the early stages are sometimes destroyed by these parasites. Consequently much attention is being paid to the parasite question, in order to determine whether it will be possible to assist the work of these beneficial insects. It seems probable that the small results gained from the work of parasites down to the present time are largely due to the recent invasion of the cotton fields of the South by the injurious insect.

COOPERATION WITH THE LOUISIANA CROP PEST COMMISSION.

Cooperation with the Louisiana Crop Pest Commission, begun in 1904, was continued during the year, three assistants being employed by the Bureau for work in Louisiana. During the season of 1905 it

was planned to enter upon an extensive study of the so-called migratory movement of the boll weevil in order to learn, if possible, some method of checking its further advances, or at least to learn more definitely the approximate time when other regions may become infested. On account, however, of the occurrence of yellow fever and the consequent rigid quarantine, it was impossible to carry on this work in full, but a number of important observations were made. In cooperation with the commission more than 25,000 weevils were carefully studied under natural conditions during the winter.

THE COTTON BOLLWORM.

The work on the cotton bollworm during the fiscal year was largely in the character of demonstrations, indicating the value of conclusions already reached and detailed in the last annual report of the Entomologist, and successful efforts were made locally in the extermination of the bollworm by means of poisons.

OTHER COTTON INSECTS.

The work on other cotton insects has been done largely in cooperation with the Texas Agricultural Experiment Station. A field agent of the Bureau was stationed at the Texas Agricultural College, devoting his attention to the other insects affecting the cotton plant. The important discovery has been made that it is possible to propagate the predaceous enemies of the cotton plant-louse, an insect which sometimes causes great damage to young cotton. It is believed that this work will lead to a practical method of controlling the pest.

INTRODUCTION OF BENEFICIAL INSECTS.

The most important work in connection with the introduction of beneficial insects has been the importing from Europe of the parasites and predaceous enemies of the gipsy and brown-tail moths, in cooperation with the officials of the State of Massachusetts.

PARASITES OF THE GIPSY MOTH AND BROWN-TAIL MOTH.

It has been shown that it is an easy matter to bring the European parasites of these injurious insects to this country, simply by collecting numbers of the larvæ and chrysalides in different parts of Europe and sending them direct to Boston. A certain percentage of these insects on arrival in New England have given out the European parasites, which have either been cultivated in wire-gauze inclosures, with plenty of food, or have been liberated in the open, there being chosen for this purpose patches of woods not subject to forest fires or to remedial work against the insects. It has been ascertained further—and this is a fact hitherto unknown even to European entomologists—that the young larvæ of the brown-tail moth in their overwintering nests in Europe are extensively parasitized. Therefore, during the winter of 1905–6 over 117,000 nests of the brown-tail moth were collected in 33 different localities in Europe, ranging between North Germany, South Hungary, and West Brittany, and comprizing a large range of varying elevations and climatic conditions. More than 70,000 parasites were reared from these nests on American soil. About 8 per cent of these were hyperparasites; that is, parasites upon parasites.

By means of specially constructed cages the hyperparasites were separated and destroyed. The primary parasites were placed in out-of-door cages or liberated in the open. The largest colonies included 10,000, 15,000, and 25,000 parasites, respectively. Owing to the very wet season a fungous disease prevailed among the caterpillars, vitiating to some extent the results of the experiments, but nevertheless three species of parasites were seen to lay their eggs in American-born caterpillars, and there is positive proof of the development on American soil of at least one complete generation of two of the European species. It has been shown that they may breed successfully thru the season.

Egg parasites of the brown-tail moth have also been imported during the summer, and have been seen to lay their eggs in the eggs of North American injurious insects. Two important European predatory ground beetles have been successfully imported, and have bred thru an entire generation upon American soil. Large numbers of Tachina flies have been reared from European specimens of the larvæ of both the gipsy moth and the brown-tail moth, and are breeding in the vicinity of Boston.

The greatest care has been taken to prevent the introduction of hyperparasites and other injurious insects, and there seems every reason to suppose that sooner or later the complete natural environment of both the gipsy moth and the brown-tail moth will be established in New England, placing them on a par with European conditions, thus greatly reducing their present importance.

NEW LADYBIRDS FROM EUROPE.

During the late winter months and spring of 1906 several species of European ladybirds, well known as destroyers of plant lice, scale insects, and soft-bodied insects of other groups, have been imported from Germany, France, and Austria. All of these have been liberated in the vicinity of the parasite laboratory at North Saugus, Mass., the country about being orchards and forests, with an occasional vegetable garden, promising plenty of food for the beneficial species.

THE KELEP OR GUATEMALAN ANT.

Efforts to successfully overwinter in Texas the kelep or Guatemalan ant enemy of the cotton boll wevil have failed and a possible useful rôle for this insect in Texas is seemingly very slight. It is possible that this species may have some economic value in some of our tropical or subtropical possessions, where the climate will be more suitable than in Texas.

THE SENDING OF USEFUL INSECTS ABROAD.

It is possible, in many instances, to secure the sending of beneficial insects by the official entomologists of other countries without expense to the Department, as was done notably in the case of the introduction of an important enemy of the black scale from the government of Cape Colony, South Africa. In return for such services and as an earnest for possible future courtesy of the same sort exportations of parasitic and predatory insects have been made, under the auspices of the Bureau of Entomology, to foreign countries. A notable instance has taken place during the fiscal year. A scale insect which occurs

abundantly upon various fruit trees in portions of the United States is a serious enemy to the mulberry tree in Italy, and therefore large sendings of parasitized scales of this species have been shipped to Professor Berlese, Director of the Royal Station for Agriculture and Entomology, at Florence. After arrival two species of parasites were bred in some numbers, and efforts are now being made to colonize them in Lombardy. It is hoped that they will prove effective aids in the eradication of the mulberry scale.

INSECTS DAMAGING FORESTS.

Investigations of insects damaging forests have progressed in a satisfactory manner in cooperation with the Forest Service of the Department. Numerous problems have been studied and a large store of general information upon forest insects has been accumulated.

Field work has been conducted from stations in West Virginia, North Carolina, South Dakota, Idaho, Washington, and California, the locations of the stations being determined by the advantages offered at the points selected for the study of some special problem or problems.

A special investigation was carried on in regard to the Black Hills beetle, which has extensively ravaged the forests in Colorado, and the results prove to be in the highest degree satisfactory and have been published in Bulletin 56 of the Bureau. The recommendations are now being actively followed by private persons with excellent chances of checking what might otherwise prove a most serious invasion.

The conditions in the Black Hills are not so encouraging, owing, doubtless, to the failure of the parties interested to realize the importance of the recommendations of the Bureau. These difficulties, however, have now been partially overcome, and all concerned seem alive to the seriousness of the situation.

Investigations in the South of the destructive pine-bark beetle and of a number of important insects injurious to forest products have been carried on, and studies have been made in regard to the insect enemies of forest reproduction. Special studies and recommendations have been made concerning the western pine-bark beetle in the region north of Boise, Idaho, and a study of the forest insects of the Pacific slope has been carried on.

INSECTS DAMAGING DECIDUOUS FRUIT TREES.

For the investigation of insect enemies of deciduous fruit trees field stations at Youngstown, N. Y., and Fort Valley, Ga., were carried on to the close of the growing season of 1905, and in the spring of 1906 others were started at Myrtle, Ga., and North East, Pa. Later another one was established at Nebraska City, Nebr. In the course of this work some studies have been made of the parasites of the San Jose scale, and experiments have been made with a number of insecticide mixtures. The chemical study of the lime-sulfur and other washes has been undertaken in cooperation with the Bureau of Chemistry. New studies have been made of the plum curculio. The peach borer has also been studied thruout its geographic range, and extensive demonstration work has been done in Nebraska on remedies for the codling moth, in cooperation with the Bureau of Plant Industry, which at the same time was dealing with the apple scab, combination

treatments for both being carried on cooperatively. Cooperation in this work is also under way with the several other experiment stations and the Georgia State entomologist.

FIELD-CROP INSECTS.

The most important work in connection with field-crop insects has been upon the Hessian fly and jointworms, especial investigations having been made of the Hessian fly in the spring-wheat regions. It was predicted that this insect would not damage wheat in regions where the spring crop is exclusively grown. This has proved to be a fallacy, and by reason of remarkable changes in the life history of the insect it has adapted itself to the conditions existing in the far northwestern country. This means a radical modification in remedial work, and the studies have indicated that it will not be difficult to bring about conditions of comparatively small insect damage. Important results have also been reached in the study of parasites of the Hessian fly, which will probably have a marked effect upon the multiplication of the fly. In the same way the jointworm investigations have resulted in the acquisition of important knowledge, both regarding possible remedial work and the handling of parasites. Studies have also been made of clover seed and clover insects, and also of other field-crop pests.

INSECTS AFFECTING VEGETABLE CROPS AND STORED PRODUCTS.

Work on insects affecting vegetable crops and stored products has been continued along the same lines as conducted in previous years. Insects affecting the sugar beet have been studied with care, and a special investigation has been made of a leaf hopper affecting this crop in Utah, Idaho, and Colorado. Many other insects of this group have been under careful observation, and results of value have been obtained.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

The work of the Bureau on the subject of mosquitoes has been continued. A further study of the yellow-fever mosquito was made in the autum of 1905, and experiments were made with remedies and methods of destruction against both larvæ and adults. Records have been brought together of the life histories and geographic distribution of the majority of the mosquitoes inhabiting North and Central America and the West Indies.

In the spring of 1906 a publication was issued upon the subject of the house fly, calling attention to its agency in the spread of typhoid fever, pointing out proper methods for its control, and urging the adoption of these methods by individuals and communities.

It was shown by observations made by the Bureau of Entomology upon a series of stables in two different sections of the city of Washington that it is a comparatively easy matter greatly to reduce the numbers of the house fly in any given community at a comparatively slight expenditure of funds and effort.

The investigation of the life history of the Texas cattle tick, mentioned in the last annual report, has been continued in cooperation with the entomologists of the States of Louisiana, Arkansas, Alabama,

Tennessee, and South Carolina. This work has considerably increased our knowledge of the development of the tick, and in connection with this work the life history and habits of a number of other common ticks, frequently confused with the fever-transmitting species, have been investigated.

SCALE INSECTS AND EXPERIMENTAL WORK WITH INSECTICIDES.

This work, in special charge of the Assistant Chief of the Bureau of Entomology, has been continued. An immense amount of material in this group is sent in to the Bureau for identification and advice and the work grows in importance and value.

A thoro inspection was made of all new plants which the Department of Agriculture is importing from different parts of the world to detect and destroy any new insect enemies, principally scale insects, which might be brought in with them.

The work with insecticides has covered tests with standard insecticides, fumigation of mills, granaries, and dwellings against insect pests, and many new insecticide ideas or mixtures, which come to the Bureau for attention almost daily, have been examined and reported on.

Tests carried on upon a large scale and in a very thoro manner with sulfurous-acid gas have fully demonstrated its usefulness.

BEE CULTURE.

The work on bee culture has greatly increased. A large number of queen bees of different varieties were reared and distributed from the Department apiary, as well as from the substation at Chico, Cal. Investigations of the giant bees of India and the Philippines were continued thru the year.

The various methods of queen rearing have been tested in rearing queens for distribution, and studies in bee diseases and in the important subject of honey-producing plants have been carried on.

SILK CULTURE.

There has been no change in the method and scope of the work on silk culture during the year. The correspondence was increased; a supply of eggs has been brought from Europe and distributed to correspondents in the United States; mulberry stock has been distributed, and cocoons have been purchased from correspondents and reeled.

OTHER INVESTIGATIONS.

Work on insects injurious to strawberry, raspberry, blackberry, and other bush fruits has been continued, and studies have been made of insects injurious to flower gardens and in greenhouses. An especial study of the insect enemies of roses is under way. The study of insects affecting shade and ornamental trees has also been continued, and an investigation has been made into the habits of the gad flies.

Routine work in the laboratory has greatly increased and biological studies have been made of nearly 500 species not hitherto studied. Increase has also been noted in the work of determining specimens for the entomologists of experiment stations and other workers. Many thousands of specimens have been received for this purpose.

BUREAU OF BIOLOGICAL SURVEY.

GEOGRAPHIC DISTRIBUTION.

LIFE AND CROP ZONES.

The Biological Survey deals with many of the problems of the farm, orchard, and stock range, and aims to answer in a practical way many of the questions that arise in their management. One of the most important of these is the selection of crops and breeds of stock adapted to the local peculiarities of temperature, moisture, and other climatic factors that prevail, not only in different areas, but which in mountainous regions often characterize different parts of the same farm. A direct and reliable guide to such selection, apart from costly experimentation, is afforded by the distribution of the native plants and animals, for it has been learned that animals and plants are not scattered haphazard over the land, but in their distribution are governed by fixt laws. Thus the association, on a given area of certain birds, mammals, trees, and shrubs, presupposes the existence there of certain climatic and physical conditions.

It naturally follows that there is a direct relation between the plant and animal life of such an area and the nature of the crops that can be grown upon it. The purpose of a biological survey of the several States is to supply life-zone maps based upon a study of the natural animal and plant life, followed by crop-zone maps with lists of fruits and crops which will best thrive in such areas. A generalized report of this nature, covering the United States as a whole, has been already published (Bull. 10, Biological Survey). The work is now being carried on in more detail and on larger scale maps in several of the Western States.

DISTRIBUTION AND MIGRATION OF DUCKS AND SHORE BIRDS.

As the game birds of the country diminish in numbers, and as their importance in the eyes of sportsmen and for food increases, the necessity of legislative protection becomes more imperative.

In order to afford an accurate basis for such legislation, the routes of migration and the time of arrival and departure of ducks and geese and the shore birds have been carefully studied.

ECONOMIC INVESTIGATIONS.

ECONOMIC MAMMALOGY.

The field included in this branch of the work is wide and important, the losses inflicted upon the agricultural and stock-raising interests in the United States by noxious animals amounting annually to many millions of dollars. The most prominent offenders are the wolves and the gnawing animals known as rodents—especially the rats and mice, rabbits, ground squirrels, and gophers. Much time and ingenuity and vast sums of money have been expended in devising means to restrict the numbers and minimize the damage done by these animals. Traps, poisons, and gases have been carefully experimented with under varying circumstances, and have proved more or less effective, but the farmer does not always possess the requisite time and skill to employ them to best advantage, and even when they serve to accomplish the object intended the cost is considerable.

Meanwhile agriculture is assuming more and more importance in the United States, and with increasing crops comes a corresponding increase in the numbers of the pests that destroy them.

In the hope of finding a remedy, the Bureau of Biological Survey is now engaged in experiments with epidemic diseases—diseases which in the course of nature break out at intervals and serve to reduce the numbers of rabbits, squirrels, mice, and other noxious animals to below the danger point. As some, if not all these diseases, are of bacterial origin, it is thought possible to obtain and preserve cultures of them for employment when and where occasion arises. Prior to their use in the field, however, a series of careful experiments is necessary to determine the character of the diseases—whether limited, as some undoubtedly are, to particular animals—the degree of their virulence, the extent of their communicability from animal to animal of a colony, and above all to make sure that human beings and farm stock are immune from their influence.

In cooperation with the Bureau of Animal Industry, experiments have been already made with a virus for destroying rats and mice, and in cooperation with the State Agricultural Experiment Station at Pullman, Wash., experiments are being tried with a disease endemic to one of the ground squirrels of that region. The results of the latter experiment are awaited with peculiar interest, since the area infested by ground squirrels in Washington, Oregon, and Idaho is very large, and everywhere over it great damage is done to the wheat crop.

With a view to eliciting timely information as to the prevalence of epidemic disease among rabbits, ground squirrels, prairie dogs, rats, and mice, a circular of inquiry has been widely distributed. The subject is one of large possibilities, and time and money will be well spent if effective and economical methods are found to relieve the farmer of part of the burden and expense of protecting his crops from rodent pests, which are as numerous and destructive as they are ubiquitous and elusive.

DEPREDATIONS BY WOLVES.

In cooperation with the Forest Service investigations are being made with a view to the reduction of the numbers of wolves on the stock ranges and on the game and forest reserves of the West. Wolves are still numerous in certain sections, and by reason of their size and strength constitute a formidable enemy to stock and to wild game. It is thought that effective means for the abatement of the nuisance have been found and a report on the subject will soon be ready for publication.

THE RABBIT PEST.

The damage to nurseries, orchards, and crops of the United States by rabbits has always been great, tho happily nowhere reaching the proportions reported in Australia. Many experiments have been made by assistants of the Survey for the purpose of discovering cheap methods of protecting orchards by wire fencing and by other means, and of reducing the number of rabbits by traps and poisons. It is believed that young trees in orchards and in forest reserves, where they are particularly liable to destruction by rabbits, can be cheaply and efficiently protected by cylinders of woven wire, and experiments are being undertaken in cooperation with the Forest Service for testing the efficiency of such protectors. Rabbits in various parts of the country appear to be peculiarly susceptible to epidemic diseases, and as they are one of our most destructive rodents special efforts are being made to detect the presence of one of these epidemics for the purpose of securing cultures as a means of reducing their numbers.

THE BOLL WEEVIL.

During the year investigations were continued in the Texas cotton districts with reference to birds that feed upon the weevil. The results are encouraging. In all, 28 species of birds have been found to be more or less active enemies of the insect. Included in this number is the nighthawk, heretofore not known to eat the weevil. The nighthawk proves to be an active consumer of the insect. Its protection by law therefore is earnestly recommended. This is all the more necessary, since the bird is often shot for food.

Of all the birds that prey upon the weevil, orioles are the most active and persistent. For this reason the possible introduction into the Gulf States of one or more additional species of these birds is being considered. Only one of the three species that visit the cotton-producing belt breeds extensively within it; hence if one is introduced it should be a species likely to make its summer home within the area infested by the weevil, as all birds are particularly assiduous in their search for insects during the time they are feeding the young.

CALIFORNIA FRUIT ORCHARDS.

Work in the California fruit orchards is being continued and a study made of the food habits of birds destructive to orchard fruit, with a view to the suggestion of preventive measures.

Careful investigations are being conducted also into the food habits of all birds that live in and around orchards, so that the orchardist may be clearly informed as to the beneficial species, in order that he may be able to discriminate between friends and foes.

SCALE INSECTS.

Few kinds of insects are so inimical to the health and existence of fruit trees and other crop plants as the scales, and owing to their small size and peculiar habits few are so difficult to cope with. It has been generally supposed that birds lend no assistance in the destruction of scales. This proves to be an error, for the Biological Survey has already found that more than 50 species of birds eat scale insects. Not only is this true, but in the case of certain species, as the grosbeaks, scales have been ascertained to form a large percentage of the food.

GAME PROTECTION AND INTRODUCTION.

The experience of many countries proves how widespread is the desire to introduce foreign mammals and birds. When these are merely for cage pets or for exhibition in zoological collections, little or no harm results. But when, as frequently happens, exotic species are liberated in the hope that they will become acclimated and form permanent additions to the fauna, there is always danger that, like the English sparrow, they will be only too successful in adapting themselves to the new environment and prove serious pests. The disastrous experiments of Jamaica, Porto Rico, Hawaii, New Zealand, Australia, and other regions abundantly illustrate this danger. Several countries take the precaution of regulating such importations, the United States among the number. Since 1900 the Department of Agriculture has supervised all importations of live birds and mammals into the United States. A few well-known species of birds and mammals are allowed to enter without special authorization, but all others are refused entry except under permit by the Department. The number thus entered during the year was 654 mammals, 274,914 canaries, and 47,256 miscellaneous birds.

The growth of the trade in imported birds is made manifest by the fact that the figures show an increase of 25 per cent over those for last year, and of 33, 27, and 37 per cent, respectively, over those for 1903–4, 1902–3, and 1901–2. Despite the large number of birds and mammals imported under permit, averaging more than 6,000 a week thruout the past year, it is believed that no prohibited species was brought into the country.

Increased interest is shown in the importation of foreign game birds for stocking covers. During the year 864 European partridges, 116 capercailzie, 73 black game, and 59 other game birds were imported for this purpose. Some of these experiments promise excellent results.

Stocking covers with birds hatched from imported eggs has heretofore been unsuccessful in most cases. Last spring, however, of 5,564 eggs imported under permit by the Department, 5,500 were English pheasant eggs secured by the game commissioner of Illinois, who reports that 3,000 live, healthy chicks were obtained—an unusually large percentage.

Large shipments of birds are examined by inspectors and the number and kinds are reported to the Department. The expense of fees has hitherto been borne by importers, since no appropriation for the purpose was made by Congress. This arrangement proved unsatisfactory and protest was made by importers. Since February 1, 1906, the Department has undertaken to pay these fees, and an appropriation should be made to sustain the service, as in the case of inspection of meats. The lack of such appropriation permits inspection only of the most important shipments.

INTERSTATE COMMERCE IN GAME.

The close surveillance of interstate traffic in game established in the Middle West has driven illegal shippers to the use of freight instead of express, and has brought the situation in that region under partial control. Attention will therefore be centered during the coming year on the Southwest, where systematic violations of the law are frequent. An effort will be made also to check numerous illegal shipments that occur in the South, particularly in West Virginia, Virginia, and North Carolina.

The limited means available for this work make progress slow and difficult. A sufficient sum should be appropriated to permit the employment of three supervisors at Chicago, St. Louis, and Baltimore, respectively, to study conditions, secure evidence of illegalities, assist prosecuting officers, and aid generally in a more effective enforcement of the law.

BIRD RESERVATIONS.

One of the most successful methods of preserving the birds of a country is by setting aside regions that contain important colonies of breeding birds as bird reservations or "refuges." England, Australia, Canada, New Zealand, and other countries have followed this plan with great success, and in 1903 the United States inaugurated it by making a bird reservation of Pelican Island, Florida, to preserve the only colony of brown pelicans on the east coast of Florida. Afterwards two more reservations were established—Breton Island, Louisiana, and Stump Lake, North Dakota—and in the year just ended four more were added to the list, two in Florida, consisting of

Passage and Indian keys, at the mouth of Tampa Bay, and two in Michigan, comprising the Huron Islands and the Siskiwit Islands in Lake Huron.

These reservations contain large colonies of water birds—ducks, gulls, terns, pelicans, etc.—and their establishment will serve to preserve certain native species from possible extermination and provide favorable places for the study of bird life. It has been found essential to have Federal authority to punish trespassers instead of depending on varying State laws, and accordingly, at the suggestion of this Department, Congress past an act (approved June 29, 1906) providing a penalty for trespass on bird and game reservations. This law will enable the wardens on bird reservations to protect them from marauders.

BIG GAME REFUGES.

It is gratifying to state that part of the herd of dwarf elk presented to the Government by Miller and Lux was successfully transferred to the Sequoia National Park in November, 1905, thus insuring the preservation of this rare species.

It is now possible, also, to transfer to an ideal buffalo range in the Wichita game preserve the herd of buffalo offered to the Department by the New York Zoological Society, as Congress at its recent session appropriated $15,000 for the construction of the fence necessary for a proper inclosure.

The plan of preserving big game from extermination by providing game refuges where shooting is either prohibited or carefully regulated is at present attracting attention all over the world. In order to profit by the experience of other countries in a matter that must soon be of pressing interest in the United States, investigation has been made of the systems employed in Canada, particularly Ontario and Quebec, the Transvaal, Natal, British East Africa, Sudan, and Cape Colony. This work has been carried on by correspondence and will be continued and extended during the coming year.

GAME PROTECTION IN ALASKA.

The preservation of the game of Alaska continues to present difficult problems. With the present unsatisfactory game law, and no appropriation available for enforcing its provisions, the efforts of the Department have been confined to preventing export of heads and skins by trophy hunters and dealers in hides, a fruitful source of destruction.

INFORMATION CONCERNING GAME.

In performance of the important duty of collecting and disseminating information relating to game, the annual summary of game laws, posters of close seasons, and directory of officers and organizations concerned in the protection of game have been published as usual, and also various pamphlets relating to special features of game protection. In the near future it is intended to secure and publish information concerning hunting-license statistics, game refuges and preserves, introduction and propagation of game birds, duties of the modern game warden, and the cage-bird traffic of the United States.

The constant demand for information on these and kindred matters shows how important is this phase of the work. It is impossible to meet this demand satisfactorily with the present limited force and available means, and an increase in both is much needed.

DIVISION OF PUBLICATIONS.

The work of the Division of Publications continues inevitably to increase with the growth of the Department. The number of publications issued in 1904 was 972; in 1905, 1,072; and in 1906, 1,171. The number of copies issued in 1906 aggregated 13,488,021. The larger proportion of these publications consisted of reprints, but the new publications in 1906, exclusive of those of the Weather Bureau, numbered 414.

FARMERS' BULLETINS.

The total number of Farmers' Bulletins issued during the fiscal year was 437, of which 404 were reprints, and the total number of copies issued was 6,568,000.

The demand for Farmers' Bulletins by Senators and Representatives, who under the law are entitled to 80 per cent of the whole number printed, has been so much larger than usual that practically none were left to carry over to the present fiscal year. There being therefore no surplus available and the appropriation for the current fiscal year being no larger than formerly, the number available for each Congressman will this year be greatly reduced. I have therefore felt obliged to include provision for an increase in the number of these bulletins in my estimates for the ensuing year. The number of copies of Farmers' Bulletins distributed during the past year on Congressional orders aggregated 5,279,476.

ADVISORY COMMITTEE.

On January 23, 1906, in accordance with your Executive order of the 20th of that month, I appointed an advisory committee on the subject of printing and publication, as follows: The Assistant Secretary, chairman; the Chief of the Weather Bureau, and the Department Editor, secretary. The rules laid down for the guidance of the committee in the Executive order referred to, conform so closely to the regulations governing the printing and binding of this Department imposed upon the Division of Publications, of which the Department Editor is the chief, that it was not found necessary by the committee to adopt a different system of work or to recommend many changes in the existing orders. The services of the committee were, however, extremely helpful in disposing of many questions submitted to it by the Department Editor, which would otherwise have called for my personal intervention. Up to date the committee has held ten meetings, not at stated times, but at the call of the chairman whenever questions of importance were ready to be submitted to it.

CONGRESSIONAL PUBLICATIONS.

Several important amendments to the law governing the public printing and binding have resulted from the special investigation conducted by the Joint Committee on Printing of the Senate and House. One of these provides that the first cost of all publications known as Congressional publications shall be charged to the printing fund of the Department itself instead of to the appropriation for the printing and binding for Congress, together with the cost of the copies assigned to the Secretary for Departmental use. This has made it necessary, of course, to secure an increase in the appropriation for printing for the use of this Department, and the additional amount estimated, as

above made necessary, has been duly appropriated by Congress. This, in reality, is not an increase, but a transfer from one fund to another.

Another amendment provides that public documents ordered printed for Congress may be printed in two or more editions not exceeding in the aggregate the total number authorized by law. This provision applies not only to the number assigned to the use of Congress, but also to the number assigned to the use of the Department. This amendment will doubtless tend greatly to prevent waste by over-publication.

LIMITATION OF APPROPRIATION FOR PRINTING.

A further amendment to the law provides that estimates for the printing and binding of each Department shall be included in a single item, and that after the expiration of the current fiscal year no appropriations other than those made specifically and solely for the printing and binding shall be used for such purposes. In this connection, I desire to place myself on record as strongly favoring the inclusion of the appropriation for printing and binding in the regular appropriation bill for the support of this Department, instead of being, as now, included in a separate appropriation in the sundry civil bill for the general printing and binding of the Government.

INCREASING DEMAND FOR PUBLICATIONS.

The demand for the publications of this Department continues to increase more rapidly than it is possible to meet them. The policy followed in the past of continuing the distribution after supplying the regular divisional lists, including libraries, agricultural colleges, and stations, exchanges—foreign and domestic—and persons actively cooperating in the work of the Department, to all miscellaneous applicants until the edition was exhausted, and then ordering a reprint to satisfy further demands, while perhaps the best method to be pursued in any plan of unlimited gratuitous distribution, was found very unsatisfactory.

In the first place, the funds at our disposal precluded the possibility of unlimited reprints, and thus, while a great many persons were supplied who undoubtedly did not need the publications they asked for, a large number of persons to whom the publication would prove useful were unavoidably left unsupplied, including very often persons whose services to the Department gave them a special claim on us for our publications. Such a plan might have been satisfactory enough in the days when the demand for the Department's publications was restricted, tho even then it was wasteful; but at the present time to undertake to supply all miscellaneous applicants—and this is the only fair way if the principle of gratuitous distribution is to be accepted—would involve a cost far exceeding any sum which Congress is likely to provide. In the face of the difficulty thus presented to me for solution, I concluded to abandon any attempt at general gratuitous distribution of all Department publications other than Farmers' Bulletins and circulars.

FIRST EDITIONS.

On April 14, 1906, I issued a general order which limited the first edition of every publication to the number of copies necessary to supply libraries, educational institutions, the press, State and foreign officials connected with agriculture, exchanges, and such persons as

render tangible service to the Department, either by actively cooperating in its work or as special correspondents, and including a small number to be reserved for emergencies and for use in correspondence, and to furnish a small supply to be placed in the hands of the Superintendent of Documents for sale. I am indebted to the courtesy of this official for the subjoined statement, showing the total number of the publications of this Department sold by him during the last fiscal year and the sums received therefor, and, for purposes of comparison, the total number sold of all Government publications and the amount received:

Publications of Department of Agriculture	copies	47,745
Amount received therefor		$5,388.28
All Government publications	copies	75,828
Amount received therefor		$16,495.88

REPRINTS BY THE SUPERINTENDENT OF DOCUMENTS.

I am also indebted to the Superintendent of Documents for a report showing that under the provisions of joint resolution No. 11, approved March 28, 1904, and with the concurrence of this office, as therein provided, 43 reprints of Department publications were ordered by him from the Public Printer during the year ending June 30, 1906, in editions of from 100 to 1,500 copies, in order to satisfy the requests of purchasers. Under the terms of the resolution referred to, these reprints, which aggregated over 10,000 copies, were paid for from the funds received by the Superintendent of Documents from the sale of our publications. This sale of Government publications under the provisions of the resolution, which authorize him to reprint as occasion requires, defraying the cost of same from the sums received by him as purchase money, affords the most equitable plan for the distribution of these publications to miscellaneous applicants. It involves no waste, meets the requirements of all parties interested at a minimum cost to the Government, and provides for a supply adequate to any possible demand.

To make this system a complete success requires the extensive advertising of the existence of these publications, and to this end this Department supplies each month to all persons desiring it a list of the publications issued during the month previous. By this means, and thru the intelligent courtesy of the press, our publications are widely advertised. A second requirement is, in my opinion, that these publications should be sold at cost of paper, printing, and binding, the cost of the first edition, which includes the making of the plates, being properly defrayed by the Government. A third great convenience would be afforded to intending purchasers if the Superintendent of Documents were authorized to receive postage stamps as cash. This is especially true where the sums involved amount to or include fractions of a dollar.

DEMAND FOR PUBLICATIONS BY EDUCATIONAL INSTITUTIONS.

A great many demands are being made upon us by educational institutions for publications of this Department to be used as text-books, and as these demands usually involve supplying whole classes of students with the same publication, the question promises to present some difficulties. Heretofore I have made it a point to grant such requests, but how long I can continue to do so gratuitously, in the face of rapidly increasing demands of this character, is problematical. In

many cases, especially where there has been cooperation between State institutions and this Department, the number desired is so great that the parties themselves desire the privilege of purchasing hundreds, and sometimes thousands, of copies.

Under the law regulating such matters the Public Printer is authorized to sell not more than 250 copies to any individual, and the applicant must file his order before the publication goes to press. In the cases I refer to this number is generally inadequate, and moreover it is impossible to comply with the condition. There is then left to the institution or official desiring them the alternative of purchasing the plates, with a view naturally to saving the cost of composition. Under the law no saving can be effected in this way. The Public Printer is compelled to charge not only the cost of the metal in making the plates, but the original cost of composition. I would suggest an amendment to the law, authorizing the Public Printer to supply duplicate plates of Government publications at the cost of such duplication, with 10 per cent added for handling, to all applicants duly indorsed by the head of the Department issuing the publication.

BUREAU OF STATISTICS.

SUMMARY OF THE WORK DURING THE YEAR.

The work of the Bureau of Statistics is performed in three divisions: (1) The Division of Domestic Crop Reports, (2) the Division of Foreign Markets, (3) the Miscellaneous Division.

As in former years, the principal work of the Bureau of Statistics has been the collection and dissemination of information regarding the acreage, condition, and yield of the principal agricultural crops of the United States.

The Division of Domestic Crop Reports handles the great mass of reports received from month to month by the Bureau for the use of the Statistician and the Crop Reporting Board in preparing the estimates of the Bureau.

The work accomplished in this division is supplemented by reports received from salaried State statistical agents, one of whom is located in each State, and from special field agents who travel within and thruout defined territory, consisting of two or more States, examining the crops in the field and securing information for the use of the Bureau from all available sources, such as country bankers, agricultural implement dealers, representative farmers, country merchants, and others.

During the year the scope of this work has been very greatly broadened, the increase being approximately 100 per cent. Twenty-five crops not previously dealt with by the Bureau have been added, concerning which reports of condition are made from month to month. This has taxed the working capacity of the clerical force of the Bureau, and has rendered it necessary that they be required to do considerable work above and beyond the regular hours of service ordinarily required.

The special field service of the Bureau of Statistics, as well as the corps of State statistical agents, has been considerably strengthened and the work of these employees has been placed upon a uniform, scientific basis, such as did not formerly prevail. The reports of the Bureau and the methods employed in making them seem to have met with general approval, and have largely increased the confidence of

producers, consumers, dealers, and the public generally in their integrity and accuracy.

In order to prevent the possibility of information regarding the reports of the Bureau being prematurely given out, methods have been adopted which render such leakages impossible. These are explained and described in detail in the annual report of the Statistician of the Bureau. The value of the monthly crop reports of this Bureau has been so thoroly established that any suggestion looking to their curtailment meets with vigorous objection and opposition from all who are interested in the promulgation of fair, unbiased estimates regarding acreages, conditions, and yields of the products of agriculture.

The Division of Foreign Markets compiles information regarding the imports and exports of all the different classes of farm products; also of manufactured products as far as the output of packing houses can be so denominated. The information thus gathered is published annually in bulletins, to which wide circulation is given. In addition to this regular work, studies are made of conditions in countries competing with the United States in the world's markets, with regard to packing-house products and meat animals, and a large amount of instructive matter has been collected and published.

Investigations have also been conducted by this Division of the world's meat trade; of the comparative healthfulness of meat animals in different countries; of the situation thruout the world with regard to cotton production; of the British market for dairy products and its sources of supply; wheat growing in Russia; freight rates, and the world's production and trade in barley, rye, potatoes, wheat, tobacco, cotton, and other agricultural products.

During the past year a very interesting study was consummated upon the subject of the increase in farm values in the United States, the results of which have been published in bulletins which have attracted wide attention and interest.

In the Miscellaneous Division of the Bureau of Statistics, which embraces the statistical library, the necessary translations incident to the work are made; and a few clerks are engaged in special work, such as the compiling and preparing of material to be used in answering inquiries for agricultural statistics made by Members of Congress and others. The services of the clerks in this Division are called into requisition in the tabulation and computation of the monthly crop reports, or for any other purpose for which they may be required.

An employee of the Bureau of Statistics is stationed in London and from that point makes trips to the different European countries, collecting information regarding crop acreages, conditions, and yields, which he sends to Washington each month for publication in the Crop Reporter, a monthly publication of the Bureau, in which are given the reports of the Bureau, placed in comparison with reports for previous years at the corresponding dates, together with various other statistical information of interest to farmers and dealers in and consumers of farm products.

Much statistical work in the way of tabulation and computation has been done for other Bureaus of the Department, and tho the regular work has been greatly increased thru the enlargement of its scope, all the statistical service required by other Bureaus has been accomplished promptly and satisfactorily. The work of the Department is being unified and made cooperative in many lines of research and demonstration.

Investigations have been carried on thru a series of years regarding the cost of producing farm products, and results of these investigations have been embodied in bulletins, which, it is believed, will be of great value and interest.

THE LIBRARY.

The growth of the Library has exceeded that of any previous year, so that at present the scientists of the Department have available for their use a collection of scientific books, periodicals, and pamphlets numbering over 92,000. All new publications of value relating to general agriculture and to special subjects concerning which investigations are being carried on by the Department have been purchased, over 500 periodicals alone being received regularly. This Library is gradually growing to be the most complete collection of agricultural literature in the country. Many valuable purchases and gifts have been included in the 5,000 additions of the past year. For the advancement of work in connection with food and drug regulations, meat inspection, and game protection an unusual amount has been expended for law books and other works published in this country and abroad relative to these subjects. Every new line of work entered upon by the Department makes a correspondingly new demand upon the Library.

CATALOGING.

The card catalog of 160,000 author and subject entries is the most valuable key to the resources of the Library. The cataloging has been kept up to date, so that the material on a given subject is readily available. Cooperation with the Library of Congress and with other institutions which print cards has enabled the Library to secure a larger number of printed cards for its catalog than ever before. These cards are not only for books and pamphlets of its own, but many show what may be found on subjects of interest to this Department in other departmental libraries. By this means the scope of the catalog is largely increased at the least cost of time and money.

The cataloging of the publications of the Department has progressed from year to year until now there is a card catalog to these documents up to the latest bulletin issued. These cards are valued by all libraries receiving our publications regularly, affording as they do the only up-to-date means of reference to all authors and subjects of the publications. On account of the increasing demands for this catalog and of the lack of space in the library for handling and storing the cards, it has been found advisable to transfer the printing and distribution of cards to the Library of Congress. This cooperation has given satisfactory results in the advancement of the work.

Not only is the library indispensable in connection with the work of the Department, but much work has been done in it by visiting specialists, and to many agricultural colleges and experiment stations temporary loans of publications not elsewhere to be found in the country have been made.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The great value of the agricultural experiment stations as agencies for the advancement of agriculture thru scientific research was recognized by Congress in a signal manner during the past year by

the passage of the Adams Act. This measure, introduced and championed by the late Hon. Henry Cullen Adams, of Wisconsin, had the unanimous approval of the committees on agriculture in both Houses, past in Congress without a dissenting vote, and received the approval of the President March 16, 1906. It provides that each State and Territory shall annually receive from the National Treasury a grant of money in addition to that given for the establishment and maintenance of agricultural experiment stations by the act of March 2, 1887 (Hatch Act). The initial appropriation to each State under the Adams Act is $5,000 for the fiscal year 1906. To this amount $2,000 is to be added each year for five years, after which an appropriation of $15,000 is to continue annually. Thus in 1911 and each year thereafter each State will receive $30,000, double the amount hitherto granted under the Hatch Act. The new act recognizes the fact that thru previous National and State legislation the stations are thoroly organized, are equipped with lands and buildings, and have funds for the printing and distribution of publications.

The extension and strengthening of the experimental work of the stations is therefore made the sole object of the Adams Act, and the additional funds are "to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States." The Adams fund is thus essentially a research fund, and if properly used should produce results of the greatest and most permanent value to American agriculture. The State experiment stations have already performed service of great value. They have done much to secure radical and wide-spread improvements in agricultural practise; they have contributed in large measure to the creation of a new American literature of agriculture and made it available to every farmer; they have collected much of the material from which a science of agriculture is being formulated as the basis for the instruction of successive generations of farmers in colleges, schools, and farmers' institutes. As their work has developed, it has naturally divided itself into several broad classes, which may be briefly summarized as (1) original research; (2) verification and demonstration experiments, often of a local character and import; (3) inspection service; and (4) dissemination of information. So great has been the local pressure for work of the last three classes that by far the greatest share of the National and State funds have been spent in these lines. The Adams fund now comes in to enable the stations to broaden and deepen their original researches, on the results of which largely depends the success of their other work.

Previous to the passage of the Adams Act the funds of the stations from sources within the States had steadily increased, until in 1905 they exceeded the revenue derived from the National Treasury. There is every reason to believe that the States and local communities will continue to deal liberally with the stations, and that thus they will be able to extend their more popular and directly practical work. The United States will thus have a much more thoro and comprehensive system of agricultural experiment stations.

Congress having put in my hands the administration of the Adams Act, I have assigned to the Office of Experiment Stations the duty of dealing with the experiment stations in matters relating to this act.

The untimely death of Mr. Adams has taken away one of the foremost leaders in the cause of agricultural progress in this country. His clear insight into agricultural problems and needs, his thoro sym-

pathy with farmers, his appreciation of the benefits accruing to agriculture from the work of properly trained scientists, his independence of thought and action, his fearless advocacy of measures which he deemed of importance to agriculture, his experience in public life both as an administrator and as a legislator, his thoro honesty, which won the respect and confidence even of those who opposed him, put him in a position to render the highest and best service in National councils and legislation. In consideration of the important social and economic changes which our rural communities are passing thru in these days, as well as of the vast material interests involved in our agriculture, the loss of such a leader is most keenly felt. Great, however, was his achievement in the short period in which he was a member of Congress, for the name of Representative Adams, of Wisconsin, will ever be linked with that of Senator Morrill, of Vermont, and Representative Hatch, of Missouri, as the author of a measure of fundamental and permanent importance to the institutions which advance and disseminate the knowledge on which our agricultural progress and permanent prosperity largely depend.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

In response to demands from numerous sources the work of the Department relating to agricultural education has been gradually broadened, until now it touches nearly every phase of the subject. This Department, thru the Office of Experiment Stations, has been active in aiding the establishment of agricultural high schools and the introduction of agricultural subjects into the curricula of the public schools. Representatives of that Office have addrest important educational and agricultural meetings in the interests of agricultural education in a number of States, have given advice regarding legislation and courses of study, and have assisted in the inauguration of agricultural instruction and the securing of agricultural teachers in different localities. The agricultural colleges have been visited and conferences have been held with their officers and teachers. A special study has been made of the agricultural work in the colleges for negroes.

The general interests of higher education in agriculture have been promoted thru cooperation with the Association of American Agricultural Colleges and Experiment Stations. As chairman of the standing committee on agricultural instruction, the Director of that Office has aided in studies with reference to the improvement of courses of instruction in the agricultural colleges and schools. He has also acted as dean of the Graduate School of Agriculture, which held a second successful session at the University of Illinois the past summer. The faculty of this school consisted of 35 of our leading agricultural teachers and experts from this Department and the agricultural colleges and experiment stations. The students, drawn from 34 States and Territories, were mainly the younger men already engaged in agricultural teaching and experimenting.

With the development of the Department's work along educational lines it has become clear that it may accomplish important and valuable service as a central agency for the promotion of agricultural education in cooperation with the State departments of agriculture and education, the agricultural colleges and experiment stations, and the State and National agricultural organizations. The most important

lines of educational effort in which the Department should engage may be briefly outlined as follows:

(1) To aid the agricultural colleges to reduce the results of the investigations made by this Department and the experiment stations to pedagogical form for use in agricultural colleges and schools of different grades. This work is now proceeding too slowly to keep pace with the accumulation of material, and the lack of well-ordered manuals and illustrative materials is a great hindrance to the effective organization of agricultural instruction.

(2) To promote the efficiency of agricultural instruction in the negro land-grant colleges, in order that the funds granted for negro education by the Federal Government may contribute toward keeping the negro on the farm and making him a more efficient factor in agricultural production for his own good and that of the nation, rather than, as is largely the case at present, drawing him away from the farm into the uncertainties and dangers of city life.

(3) To aid the agricultural organizations in the several States in promoting an efficient organization of agricultural high schools, consolidated common schools, and other educational agencies best adapted to secure a high state of prosperity and contentment in rural life. It is along these lines that the great educational effort of the immediate future is to be made. The forces behind the movement for industrial education have hitherto devoted themselves very largely to the promotion of instruction in the city industries. It is now apparent that a similar work needs to be done for the great fundamental industries grouped under agriculture. Much work will be required to bring the masses of our agricultural population into sympathetic touch with the progressive movement in education and to secure for them a school system in harmony with their environment and their relations to the world's work and civilization. As the nation's representative of agricultural enlightenment and progress, this Department should be in a position to render effective aid in this enterprise, on the success of which depends so largely the permanent prosperity and contentment of our agricultural people.

(4) Since the success of agricultural instruction in the public schools will depend very largely on the teachers, this Department should aid the agricultural colleges and other State educational institutions in preparing and inaugurating training courses for teachers of agriculture in secondary and elementary schools.

(5) Since agriculture as a fundamental industry is of vital importance to all our people, this Department should present such results of its work and that of the experiment stations at home and abroad as are adapted to instructional purposes in connection with nature study and elementary agriculture in a form available to teachers and pupils in both country and city, the object being to impress our youth with the dignity, value, and attractiveness of country life and pursuits.

THE FARMERS' INSTITUTES.

Interest in the farmers' institutes continues to increase thruout the country, and a larger attendance is reported for the past year than ever before. The Department is keeping in close touch with the State organizations under which the institutes are held, and is especially aiding the lecturers to obtain up-to-date information regarding the progress made in agricultural science and practise. In many localities there is a demand for more extended and definite instruction than

can be given in the ordinary institutes. The Department is therefore having short courses of lectures prepared by experts, which may be used in so-called movable agricultural schools. Inquiry is also being made regarding the value of various other means more or less extensively used for interesting farmers and their families in improved practise on their farms and in their households. Representatives of the Department have accompanied the special railroad trains which have carried exhibits and lecturers to thousands of farmers in many parts of the country and have proved popular and effective means of awakening interest in the work of the Department and the experiment stations. The farmers' institutes and other forms of what is often called extension work in agricultural education are very important supplements to the publications of the Department and the stations, as well as to the regular work of the agricultural colleges and schools. The Department should share in this extension work and seek to promote its general interests.

EXPERIMENT STATIONS IN ALASKA, HAWAII, AND PORTO RICO.

A systematic effort has been begun to determine the feasibility of the live-stock industry in Alaska. A small herd of Galloway cattle has been purchased and located at Kenai, in Cook Inlet, and at Wood Island. These cattle have subsisted during the summer upon the native grasses, and a considerable supply of grain hay has been grown at the Kenai Station with which to maintain them during the winter. Wheat, rye, barley, and oats matured in 1905 and 1906 at the Rampart Station in the Yukon Valley, but 300 miles farther south, in the Copper River Valley, cold and drought killed all but the hardiest varieties of cereals. A large amount of grain hay was obtained at the Copper Center Station and sold at a highly remunerative price. It has been shown that many of the Alaskan soils require lime, and a method has therefore been devised for the cheap local production of lime in small quantities. Arrangements have been made to open a station near the prosperous mining towns of Fairbanks and Chena, on the Tanana River, as soon as funds are available for this purpose.

The Hawaii Station reports an increasing appreciation of its efforts toward diversifying the agricultural industries of the islands, and as a direct result of three years' experimental work with tobacco it is said that this year fully 200 acres were planted. The discovery by the station chemist that Hawaiian feeding stuffs are deficient in lime is an important one, and will make it possible to arrange more satisfactory rations for live stock. The investigations on the marketing of tropical fruits promise to open markets in the Pacific coast, which can best be supplied from Hawaii. Investigations begun with the object of rehabilitating the rice industry have been so favorably received that private individuals have generously contributed considerable sums of money to aid in carrying them on.

The Porto Rico station is extending its influence, and requests for cooperative work are coming from numerous sources. While the income of the station has been too limited to enable it to meet these demands, yet they show a growing sentiment in favor of the station which is very encouraging. The coffee experiments have begun to show results, and the improved methods of pruning and cultivation are quite apparent in the increased yields obtained. A successful effort is being made to grow lowland rice, and this industry should be greatly extended. The Porto Ricans are large consumers of rice, most of

which is now imported. Among the forage crops experiments with cowpeas have been most successful, and it is believed that they can be grown thruout the island. Numerous horticultural experiments are in progress, and studies are being made of insect pests and plant diseases.

The work of the stations in Alaska, Hawaii, and Porto Rico is now so well established that they can profitably make use of increased funds. Considering the fact that all buildings, equipment, and live stock must be provided for these stations from the Federal funds, there is even greater need of more liberal appropriations for their maintenance than in the case of the State experiment stations. I therefore recommend that an appropriation be given to the stations in Alaska, Hawaii, and Porto Rico equal to the amount given the State stations under the Hatch and Adams acts.

PROGRESS IN NUTRITION INVESTIGATIONS.

The investigations on the food and nutrition of man, conducted in different States and Territories under the auspices of the Office of Experiment Stations, have, as in the past, been carried on in cooperation with universities and other schools, as well as public institutions, but chiefly with agricultural experiment stations and agricultural colleges. By this cooperation the Department funds have been materially supplemented in various ways and the scope and possibilities of the work greatly increased. The chief object of the investigations is to learn the nutritive value of agricultural products of animal and vegetable origin and the proportions in which such food materials of different kinds may be most intelligently used to the advantage of both producer and consumer. The general policy has been to undertake, in the different centers of investigation, work for which the institution or region offered exceptional facilities. Thus, at the California Agricultural Experiment Station studies have been undertaken with fruits and nuts and the products made from them; at the Minnesota and Maine experiment stations with wheat, corn, and other cereal foods; at the University of Tennessee with cowpeas and other legumes; and at Wesleyan University, Middletown, Conn., with cheese made and cured in different ways. New experiments have been undertaken whenever the finishing up of any line of work has rendered this possible, and it has been the purpose to select for study especially those problems which have a direct bearing upon agriculture.

The experiments which have been conducted at the California Agricultural Experiment Station have furnished additional evidence of the considerable amount of nutritive material which may be supplied in readily digestible form by fruits and nuts intelligently used as part of the diet. It appears further that fruits and nuts are more useful when eaten in combination with other food materials than in large quantities by themselves or at the end of an otherwise hearty meal.

The studies of cereal breakfast foods undertaken at the Maine and Minnesota experiment stations have shown that different classes of goods made from the same grain do not differ materially in nutritive value tho there is a considerable range in price. As a whole, cereal breakfast foods are nutritious and reasonably economical. As regards digestibility they closely resemble bread made from the coarser flours and are somewhat less thoroly assimilated than bread made from white flour. It has also been shown that flour products other than bread closely resemble bread in digestibility and total nutritive value.

From studies with corn products, undertaken at the Maine Experiment Station, it appears that corn bread of different sorts has about the same digestibility as bread made from coarse wheat flour, and that it is well worthy of a place in the diet as a reasonably inexpensive source of nutritive material, as well as for the sake of variety.

The studies of different methods of cooking meat carried on at the University of Illinois have shown that it is possible to control cooking processes so that a fairly uniform product may be obtained when similar cuts of meat are cooked by either boiling or roasting. As a whole, meats of different kinds and cuts supply nutritive material, particularly protein and fat, in forms which are very well assimilated.

Investigations on the digestibility and nutritive value of cheese carried on at Middletown, Conn., have shown that cheese (American cheddar) is very thoroly assimilated and is not productive of digestive disturbances as commonly supposed. When desired it may be used in comparatively large quantities as an inexpensive source of protein and energy in the diet. Cheese, being rich in protein and fat, should be combined with cereal foods, fruits, and similar products, which supply an abundance of carbohydrates, and when eaten in considerable quantities should replace rather than supplement such nitrogenous foods as meat, eggs, and dried legumes. The experiments furnish the first extensive demonstration by scientific methods of the high nutritive value of this important dairy product. The great importance of cheese as a source of protein has not been hitherto appreciated and in a sense its commercial value as a food has lacked satisfactory basis.

The investigations carried on with the respiration calorimeter at Middletown, Conn., have furnished new and valuable factors regarding the average amount of energy in the form of food required by men at rest and performing various kinds of work, the carbon dioxid and energy output at different times of the day under different conditions of work and rest, and related topics.

The investigations undertaken at the Hawaii Agricultural Experiment Station have furnished interesting data regarding the nutritive value of tropical food products and the kinds and amounts of food consumed by persons living under different circumstances in tropical regions.

At Columbia University, New York, the investigations which have been undertaken furnish new and valuable data regarding the demands of the body for the ash constituents of food.

The results of the nutrition investigations are made public by means of technical bulletins and popular summaries, and a great deal of miscellaneous information is also supplied to teachers, students, and other persons by means of correspondence, the increasing demand for publications and other data being an indication of the favorable way in which the work is regarded by the people at large.

Extended use has been made of the nutrition publications as text-books in a large number of schools, colleges, and medical schools thruout the country, owing to the fact that satisfactory text-books on these subjects have not hitherto been available. In this connection it may be mentioned that there are 45 agricultural colleges or similar institutions receiving Government aid for white students, and an equal number for colored people, where some of the courses of instruction necessitate the use of such data.

The proper economical feeding of families or groups—that is, the best methods of utilizing the food products which come from the farm—is a subject the importance of which can hardly be overestimated, and a knowledge of the important facts regarding the nutritive value of different foods can not fail to bring about improved standards of living on farms and elsewhere and benefit alike the producer, distributer, and consumer of food products.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

Three years ago the Office of Experiment Stations detailed some of its irrigation experts to work out and introduce the right methods of irrigation in some of the older districts where water is scarce and costly and where skill and economy in its use are of the utmost importance, and also took up giving practical advice to beginners in irrigation in sections where irrigation was being introduced. The conditions under which these men worked therefore were widely different, but the results have been the same in each case. Wherever this educational work was begun there has been a marked appreciation of its value. Each one of these men has become a fixture in the State and section where he was first located. Every attempt to send him to a different section to take up this work has been met by protests and remonstrances which could not be disregarded. The result has been that requests for similar work in other localities made by Members of Congress, governors, and communities could not be responded to, altho the value of the work and the reasonableness of the requests were fully appreciated. To meet these demands the number of men engaged in this work should be increased during the coming year.

Thus far this work has been carried on entirely in aid of settlers under private works, but it is believed that the time has come when this Department should take up the work of educating and aiding settlers under Government reclamation projects, and that experts should be detailed to these projects to show the methods of applying water which should be adopted, the kind of tools to be used, the time when land should be irrigated, the quantity of water which should be used, and the cultivation which should follow this use.

The experience of the past few years has also shown that this educational work and the successful conduct of original investigations can both be best carried on thru the establishment of farms where the best methods can be worked out and illustrated and their results demonstrated. While bulletins and reports are of great value, they are not equal to an object lesson. Nothing will teach these farmers how they should do their work so quickly as to be able to see fields prepared in the right way, water handled in the right way, and the soil cultivated in the right manner. I believe therefore that on each reclamation area a demonstration farm should be established, on which the methods of irrigation can be taught by a practical expert from this Department, and trust that provision will be made for this by the next Congress.

Five irrigation extension stations for the demonstration of methods of using groundwater and flood and storm waters in irrigation as supplementary to dry farming have been located in the semiarid belt during the past year. At these stations it is expected to work out and demonstrate the methods and practises for utilizing limited water supplies in the irrigation of from 1 to 10 acres of land, and the methods of irrigation and tillage needed to conserve this moisture in the

soil, and the benefits which will come by making such irrigation a feature of every semiarid farm. This work has assumed a new importance because of the great wave of settlement which is now sweeping over this region.

A number of influences, some of them proper and some questionable, are aiding in this settlement. Among those that are legitimate are the greater possibilities due to the introduction of drought-resistant crops, the improved methods of tillage, and the series of wet years with which that section has been favored. But there will come other dry years, and the permanent prosperity of these settlers will largely depend upon their having fortified themselves against the risk of drought by utilizing every opportunity for a water supply that the region affords. Nothing will aid more to enhance their comfort or relieve them from the danger of dry years than to have from 1 to 10 acres of land irrigated where crops can be grown regardless of the rainfall. Provision for such irrigation will enable the farmer to grow trees for fruit and shade, have a limited area of high-priced products, enough vegetables for his family, and forage for his cows and horses. It will also enable him to make the surroundings of his homestead attractive, thus adding to the comfort and contentment of country life in these regions.

That the demonstration farm is an effective influence in promoting the extension of this kind of irrigation has been proven by the results of the oldest of these stations located at Cheyenne, Wyo. This station, thru the utilization of underground waters lifted by windmills, has produced crops equaling those of the old irrigated districts. It has shown the extent and value of water resources hitherto neglected. The station was visited during the year by fully 5,000 people, and its methods and results observed and described in a large number of scientific newspapers and magazines, as well as the local press of that region. It has encouraged a large number of farmers to conserve and utilize water supplies which were hitherto going to waste, and the year's results are considered as marking the beginning of a new era of agriculture in that section.

In many parts of the arid and semiarid region water for irrigation can be secured only by pumping. The Department has a constant call for information as to the cost of such irrigation and the types of pumps and the kind of power which should be used. We have collected a large amount of information on these subjects, which is now being prepared for publication, and recently have inaugurated some comprehensive tests to determine the value of alcohol as a power agent in pumping water for irrigation and drainage, and in other agricultural work, with a view to giving practical information to farmers about the value of denatured alcohol as compared to gasoline, and the conditions under which it should be used to secure the maximum efficiency.

Every year the area of irrigated land that needs drainage is increased, which proves that irrigation and drainage must go hand in hand. During the past year the Department has been carrying on extended drainage investigations of some of the irrigated districts injured by surplus water in Utah, Washington, Nebraska, and California, this work been paid for in part by State appropriations. These investigations have been carried on as a preliminary step in the preparation of drainage plans.

The past year has also demonstrated the benefits of good engineering in securing the efficiency of drainage as a remedy for alkali. The drains put in by the farmers of Utah on lands which were regarded as ruined by alkali have so relieved the lands in a single year that they are now ready for cultivation, and land drained three years ago according to plans prepared by the engineers of this Department, this year produced $75 worth of sugar beets to the acre. Equally encouraging results on a larger scale have followed the carrying out of the plans of the Department's engineers in the State of Washington.

The drainage of the swamp overflowed lands in the humid parts of the United States would extend or greatly improve agriculture over an area almost equal to that of the States of Illinois, Indiana, and Ohio. This makes farm drainage a matter of National interest and importance. Nor will the increase in agriculture mark the full measure of the benefits of this drainage. Many of these swamps are a menace to the health of surrounding neighborhoods and a great obstacle to the development of commerce and manufacturing. The reclamation of some of these areas, like the coastal swamps of the Carolinas, the Everglades of Florida, and the St. Francis Basin in Arkansas, presents agricultural and engineering problems of great complexity, which can not be solved by private enterprise; the cost and the area of country involved are both too great. As a rule agricultural drainage requires special legislation to provide for the organization of the district to be benefited and the raising and expenditure of funds under public or semipublic authority. The general interest manifested in drainage in this country and the large amount of work done at present, has given rise to many important questions, legislative, financial, engineering, and agricultural. The calls on the Department along these lines have been far greater than could be met. During the past year it has rendered important aid by conferences with State officials and others in making surveys and investigations to determine the feasibility of large drainage projects and prepare plans for the work. During the year this Department has carried on these surveys and investigations in thirty-one of the forty-six States.

OFFICE OF PUBLIC ROADS.

Thruout the country, and more particularly in the rural districts, there is a steadily growing demand for information as to the best methods of road construction. Considering the country as a whole, it is probably true that in no phase of development are we so backward as in the extension of hard and durable roads. In the cases in which the people are willing to expend money on the improvement of their highways, it frequently happens that, owing to inexperience and lack of organization, the money is partially or totally wasted. In some communities abundantly able to support a system of good roads, very little work is done, owing to a lack of knowledge of what can be accomplished with the resources at hand. It is precisely in cases like these that the work of the Office of Public Roads is proving of signal value. While it is no part of the scope of its work to undertake the construction of roads that can be and should be the care of communities within the States, the educational value of employing expert supervision, as well as, to a limited extent, machinery for the construction of sections of improved roads in different parts of the country, has been amply demonstrated.

The act of Congress making appropriation for the Office of Public Roads makes three distinct requirements in relation to the work to be performed, viz, to investigate systems of road administration thruout the United States, to give expert advice on road construction, and to investigate the chemical and physical properties of road materials. During the past year the work of the Office has been arranged in three general divisions along the lines indicated.

The Office is also collecting information as to comparative cost of road work, methods of building various types of roads, State-aid roads, legislation regarding road management, the value of wide tires, the use of convict labor in road building, cost of wagon transportation, and bond issues for road improvement. Numerous inquiries are received asking for information on the subject of the road laws of the various States, and a complete digest of the road laws of all the States is being prepared for publication.

EXPERT ADVICE ON ROAD CONSTRUCTION.

Expert advice on road construction has been given and experimental field work carried on by the Office. There were employed on this work at the close of the fiscal year, in addition to the chief engineer, 3 engineers, 1 consulting engineer, 6 engineer students, 6 road experts, and 5 expert roller operators. Whenever it is possible and where application has been made in the proper way, object-lesson roads are constructed for the purpose of illustrating the best methods of road building. The local authorities furnish all material, common labor, teams, and fuel, the Office supplying supervising engineers and in some cases part or all of the necessary machinery. In addition to this, tests are made to determine the best material available for the road. It frequently happens that these short sections of object-lesson roads have subsequently led to the construction of fine systems of improved roads in the localities in which they were built. During the past fiscal year 17 roads were built in 11 States, representing a wide diversity in character of construction and kinds of material used.

In many cases in which it is not deemed advisable to undertake the construction of an object-lesson road, engineers and experts of the Office are able to give advice that enables local authorities to improve the conditions and surmount difficulties. It is evident that where only small amounts of money are available for road improvement it is frequently better to improve the highways already existing than to attempt the construction of macadam roads. Special attention has been given to this phase of the work and the Office has been able to do much in developing the use of sand clay and burnt clay for roads in large areas of country, especially in the South, where no stone is available.

In order to give expert advice on special problems which are continually arising in road construction and maintenance, it is necessary to carry on experimental work. During the past year methods of rendering roads dustless have been investigated. The growing use of motor vehicles has presented a new and difficult problem to engineers and road builders. Systematic experiments were carried on at Jackson, Tenn., during the spring and summer of 1905, in cooperation with the city engineer, to determine the value of coal tar for preventing dust and preserving the surface of macadam roads. Tests were also made with Texas oil and its residuums on earth and macadam roads. The

expense entailed in these experiments was small. The quantity of tar applied per square yard averaged 0.45 gallon and the cost of labor for applying this quantity of tar was less than 1 cent per square yard. After more than seven months, including the winter season of 1905–6, the tarred roads are still in excellent condition.

Additional experiments were conducted during the summer of 1906 on the Potomac River drive in Washington, D. C., in cooperation with the Superintendent of Buildings and Grounds. Crude coal tar similar to that used at Jackson, Tenn., was used in this work. These experiments have been completed but a short time. The great demand which exists all over the country for some sort of treatment of road surfaces to suppress the growing dust nuisance has developed a number of materials which it is claimed will answer the purpose. Many of these materials, which are mainly emulsions of oil and tar with water, have been given trade names and patented. It is to be hoped that careful experiment will show that some material like crude coal tar, which can be obtained and easily applied wherever there is a gas plant, will prove to be efficient if properly used. It may be said that a large number of trials of crude tar in France and a few in this country, notably the one at Jackson, Tenn., have given excellent results. In other cases partial or entire failure has followed the experiments, and it yet remains to be determined whether the successful use of materials of this nature can be developed. The Office will make unremitting efforts to solve this problem by such experiments as can be carried on in different parts of the country in cooperation with local authorities.

In order to recruit the ranks of engineers that are necessary to the success of the work of the Office, the plan was adopted of appointing graduates from civil engineering schools to the positions of civil engineer students, as fully explained in the annual report of the Office of Public Roads for 1905. Up to June 30, 1906, nine students had been appointed, at $600 per annum. Of this number three have been given permanent appointments at increased salaries. The other six have not yet completed the one-year course.

A number of schools and colleges have within recent years established summer schools in road building.

INVESTIGATION OF THE PROPERTIES OF ROAD MATERIALS.

During the past year 384 samples were received at the laboratory for routine tests, of which number 273 were samples of rock, intended for macadam road building. Of the 273 samples received, about 42 per cent were limestone, 11 per cent dolomite, 10 per cent trap, 8 per cent sandstone, and 8 per cent granite. The remaining samples were of a miscellaneous character, including brick, cements, and sand. Some of this testing work is done in cooperation with various Departments of the Government. A comparison of the demand for tests with the records of previous years shows that it has increased about 33 per cent.

A significant fact, in connection with the laboratory work, is that a very large number of samples have come from the Eastern and Middle States, which have not received much assistance in the form of object-lesson roads. This tends to distribute uniformly the benefit arising from the work of the Office.

There is a growing amount of cooperation between the various State geologists and the Office in the preparation of data showing the character of material suitable for road work in the different States. From one State alone more than 80 samples have been tested. The information thus secured has been used in a bulletin, recently prepared and published by the geologist in charge, on the road-building resources of this State. Chemical and physical examinations have included practically all materials which directly or indirectly come into use in road construction.

The studies of decomposition of various kinds of rock dusts under the action of water, which were undertaken in order to determine the reasons for the important quality of binding power in macadam-road materials, has brought to light some specially interesting facts. For instance, it has been found that by mixing certain rocks of inferior binding power on the surface of the road a much higher binding power results, as in the case of limestone and granite. As the binding or cementing power of rocks is one of the chief factors in the life of a road, the value of this discovery is of obvious importance. These results, originally obtained in the laboratory, have been confirmed by observation and experiment on roads. In the course of this investigation it was found that the decomposing action of water on certain types of ground rocks went much further than had been previously believed to be the case. This applies to the alkalies, and especially the potash, contained in many rocks. The results have suggested the possible use of ground rock as a potash fertilizer. Work along this line has now been turned over to another Bureau of the Department, where it can be appropriately followed up and carefully investigated.

Owing to the numerous complaints of farmers in regard to the rapid deterioration of the modern fence wire in comparison with that manufactured in former years, an investigation of the subject was begun to see what could be done to remedy the defect. Farmers' Bulletin 239 contains a report of this investigation, which has aroused the interest of manufacturers and has determined some of them to take active steps toward producing a fence wire more resistant to atmospheric corrosion.

The scarcity of timber in many sections of the country, not only for construction work, but for fence posts, has in recent years led to a more general use of concrete. This material is admirably adapted for farm purposes, but there seems to be a general lack of knowledge concerning its preparation and use. After a series of tests and investigations, Farmers' Bulletin 235 was issued, giving full information concerning cement, cement mortar, the mixing of concretes, and the construction of concrete sidewalks, driveways, fence posts, etc. A number of persons thruout the country who claim to have obtained special patents on concrete fence posts have attempted to prevent farmers from constructing their own posts by threats of prosecution for infringement. In view of the fact that concrete construction of all kinds reenforced with plain, straight, metal strips, bars, and tubes has been in general use in all countries for many years, the claims of such persons are usually without warrant. The Office has been enabled to be of great service to farmers by making it clear to them that, unless special forms and devices of reenforcement were employed which were distinctly patentable, no rights were infringed by the use of concrete with plain metal reenforcement.

Before being assigned to work in the field the engineer students employed in the Office receive a course of instruction in the testing laboratory. This work consists in actually making the various tests of road materials and computing results. The information thus obtained is considered necessary in connection with the selection of the best materials for road construction before a thoro understanding of the relations which exist between laboratory tests and the behavior of these materials under traffic can be gained.

A number of new projects and lines of investigation have been mapped out for the immediate future.

Outside of the laboratory a study of road machinery will be undertaken to determine the suitability of various types for different kinds of road work.

Cooperation will be sought with the Geological Survey for the purpose of indicating the various classes of roads on topographic maps issued by the Survey. Cooperation has been begun with the Forest Service in laying out and constructing wagon roads and trails in forest reserves to facilitate lumbering. As a beginning one engineer has been detailed to this work and has been some months in the Yellowstone Reserve. The field report indicates that much good will follow the preliminary survey which has been made.

Cooperation with the Post-Office Department has been begun in order to facilitate rural delivery by the improvement of country roads. This work is of vital importance. The plan, which carries the approval of the Secretary of Agriculture and the Postmaster-General, provides that whenever a road upon which a rural route has been or is about to be established is reported by the carrier or inspector to be impassable or in bad repair, the Fourth Assistant Postmaster-General will advise the Director of the Office of Public Roads of the fact and request that he have an engineer inspector detailed to examine the road and give such advice and instruction to the local officials as may be required.

Upon receipt of such information from the Fourth Assistant Postmaster-General, the Director of the Office of Public Roads will communicate with the local officials and supply them with a copy of the circular of instructions and a blank form for making application for the detail of such engineer inspector. It is not the purpose of the Office of Public Roads to actually construct the road or to make any contribution in money, materials, or labor. In most cases a road is impassable on account of defects which can be remedied by the use of proper methods. The engineer inspector who examines the road will note carefully all such defects and advise as to what steps can be taken to place the road in proper condition without great expense. If practicable, and if so desired, he may in some cases assume temporary direction of the work for the purpose of instruction.

As the chief aim and purpose of the Office of Public Roads is to bring about a general and uniform improvement of the country roads thruout the United States, a cooperative plan such as the one described above offers the best possible means of achieving positive results in furtherance of that purpose. By this means correct methods of road building and road maintenance will be introduced into practically every section of the country. The engineer inspectors assigned to this work will, in visiting places which have requested assistance of this character, follow an itinerary which will include a number of places in a given territory. This will greatly minimize the expense of each

inspection and permit the inspector to cover a much larger territory than would be possible in a special assignment to each place. A beginning has been made during the current fiscal year, and efforts will be made to increase the scope of the work in the future.

EXPENDITURES AND EMPLOYEES.

Congress appropriated $7,175,690 for the maintenance of the Department of Agriculture for the year ended June 30, 1906. This was $1,081,150 more than the appropriation for the preceding year. In addition the Department received from various sources, chiefly sales of products, $15,473.45. At the close of the year there was still unexpended, of the appropriation, $1,175,362.15, nearly all of which will be required to meet outstanding obligations. The unexpended balance for the year 1904 ($55,712.37) was, on June 30, 1906, covered into the Treasury. The account for 1905 was still open. Of the special appropriations aggregating $1,250,000 for new buildings, $642,107.25 had been expended prior to September 10, 1906.

For the current year (ending June 30, 1907) Congress appropriated $9,210,440 for the regular work of the Department. The increase is chiefly due to the broadening of the meat inspection. For that service the permanent appropriation is $3,000,000. The estimated revenues of $700,000 from sales of products of the forest reserves and $780,934.68 available for the new buildings bring the total amount to be disbursed by this Department during the current year up to $10,691,374.68.

The number of persons on the rolls of the Department of Agriculture on July 1, 1906, was, outside of Washington, 4,648; in Washington, 1,594; total, 6,242, showing an increase during the year of 796. Of the total number, more than 1,800 have been on the rolls for six years or longer. In the classified service 917 were promoted in salary and class, and 403 resigned. The total number of deaths during the year was 28.

NEW BUILDING FOR THE DEPARTMENT.

The act approved February 9, 1903, authorizing an appropriation of $1,500,000 for a new building, made possible the beginning of the construction of suitable quarters for the accommodation of the Department's work.

It was very necessary in the new building operations to make arrangements for future requirements, and with this in mind, together with the imperative need for suitable laboratories to carry on the important investigations of the various Bureaus, it was concluded to erect two segments of a building, so arranged that extensions could be provided as required, these segments to be used primarily for laboratory work and to provide fireproof accommodations for the Library. Contracts have been awarded for structures of suitable type and design to correspond with other Government buildings in the city, the base being constructed of granite and the superstructure of white marble.

The work has now progressed, with the exception of the interior finish, to approximately the fourth-floor line, and it is probable that the roof will be on before the winter season. The roofing and closing in will allow the interior work to be carried on during the winter without interruption, which, without unforeseen complications, will

insure the completion of operations within the contract time, namely, November 14, 1907, and within the $1,500,000 authorized by Congress. The mechanical equipment work, including the heating and ventilating apparatus, the electric wiring and conduit systems, and the electric elevators, has been started, and these systems will be ready for use at the time of the completion of the buildings.

The estimated growth of the Department, made at the time the appropriation for the new building was approved, has been greatly exceeded. Statistics show that there has been during this period of approximately three and one-half years, exclusive of the Weather Bureau, an increase in the number of employees of from 1,037 to 1,483 in Washington, D. C., making a percentage increase of 43. Further, the space required by this force of employees has increased from 137,963 square feet to approximately 264,000, this being a 99 per cent increase, and the rentals paid from the Department appropriation have increased from $21,700 to $54,408.96, or over 150 per cent.

This rapid increase will require other segments of the proposed buildings to be constructed before the Department will have sufficient and suitable accommodations for its work and before the large amount paid annually for rentals can be substantially decreased.

To carry on the work of the Department in an efficient manner on the lines laid down in the foregoing report has necessitated provision for somewhat increased appropriations. This report will fall short of its purpose if it has not made clear the importance of the interests the Department is designed to serve, and the necessity for carrying on its work. Moreover, the duties devolving upon it are imposed upon it by law, and it is with full appreciation of these several considerations that estimates for its expenses must be viewed. The estimates for the ensuing year have been most conservatively prepared, based upon the lines of work imposed upon the Department by the Congress, and I earnestly commend them to the favorable consideration of that body.

Respectfully submitted.

JAMES WILSON, *Secretary.*

WASHINGTON, D. C.,
November 24, 1906.

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